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A METHOD FOR EXPOSING THE ANTERIOR PORTION OF THE FRONTAL LOBES OF THE BRAIN 1053
Ernest Sachs, M.D. ..... St. Louis, Mo.
SOME ASPECTS OF THE DIAGNOSIS AND SURGICAL TREATMENT OF TUMORS OF THE SPINAL CORD 1057
Charles A. Elsberg, M.D. ..... New York, N.Y.
BONE TUMORS 1074
Frederik Carl Christensen, M.D. ..... Racine, Wis.
PLEXIFORM NEUROMA 1093
Thomas P. Mullen, M.D. ..... Pocatello, Idaho
FINAL RESULTS OF THE OPERATIVE TREATMENT OF GASTRIC ULCER 1102
Karl A. Meyer, M.D., Wm. A. Brams, M.D. and W. N. Graves, M.D.
Chicago, Ill.
THE OPERATIVE TREATMENT OF ARTHRITIS DEFORMANS OF THE HIP-JOINT 1108
Royal Whitman, M.D. ..... New York, N.Y.
PROSTATIC ABSCESS 1115
Leon Herman, M.D. and Jay Carp, M.D. ..... Philadelphia, Pa.
SPASTIC OBSTRUCTION TO THE URETERS 1133
Thomas N. Hepburn, M.D. ..... Hartford, Conn.
TORSION OF THE SPERMATIC CORD 1142
Max Thorek, M.D. ..... Chicago, Ill.
TRAUMATIC ANEURISM TREATED BY EXCISION AND END-TO-END ARTERIAL SUTURE 1150
W. Wayne Babcock, M.D. ..... Philadelphia, Pa.
POST-OPERATIVE COMPLICATIONS 1160
J. Bernhard Mencke, M.D. ..... Philadelphia, Pa.
THE SURGICAL SERVICE AT THE HOSPITAL OF THE UNIVERSITY OF PENNSYLVANIA 1164
I. S. Ravdin, M.D. ..... Philadelphia, Pa.
TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY 1177
Stated Meeting Held February 11, 1925
TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY ... 1198
Stated Meeting Held March 2, 1925
BOOK REVIEWS: *Wheeler:* Handbook on Operative Surgery. *Fitzwilliams:* On the Breast. *Faure:* Cancer de L'Uterus. *Cushing:* The Life of Sir William Osler 1207
CORRESPONDENCE: *Moynihan:* Transplantation of Extroverted Bladder into the Rectum 1211
INDEX 1212

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ANNALS of SURGERY

VOL. LXXXI JUNE, 1925 No. 6

A METHOD FOR EXPOSING THE ANTERIOR PORTION OF THE FRONTAL LOBES OF THE BRAIN

BY ERNEST SACHS, M.D.

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THE usual method for exposing the frontal lobe consists in making an osteoplastic flap with the base in the temporal region. The anterior portion of the incision is carried across the forehead and no matter how perfect the approximation, this incision is somewhat disfiguring. For that reason, I have been making use of a different incision for a number of years which gives one an admirable exposure of the frontal lobe and leaves the scar almost entirely in the area covered by hair. The following illustrations are self-explanatory. Figures 1 and 2 show the type of incision that is used when one frontal lobe is to be exposed. Figures 3, 4 and 5 show the incision if one wishes to expose both frontal lobes at one time.

FIG. 1.—Field of operation for exposing one frontal lobe of brain.

A cranial flap, to fulfill all the necessary requirements, must be so planned that first of all there is ample room for exploration; secondly, the bone flap when replaced must fit accurately; and thirdly, there must be a place provided for a decompression opening which will be well covered by muscle so that herniation may not be disfiguring. It has been my custom, as has been the custom of all neurological surgeons in recent years, to combine a decompression opening with a craniotomy in all cases in which the tumor either was

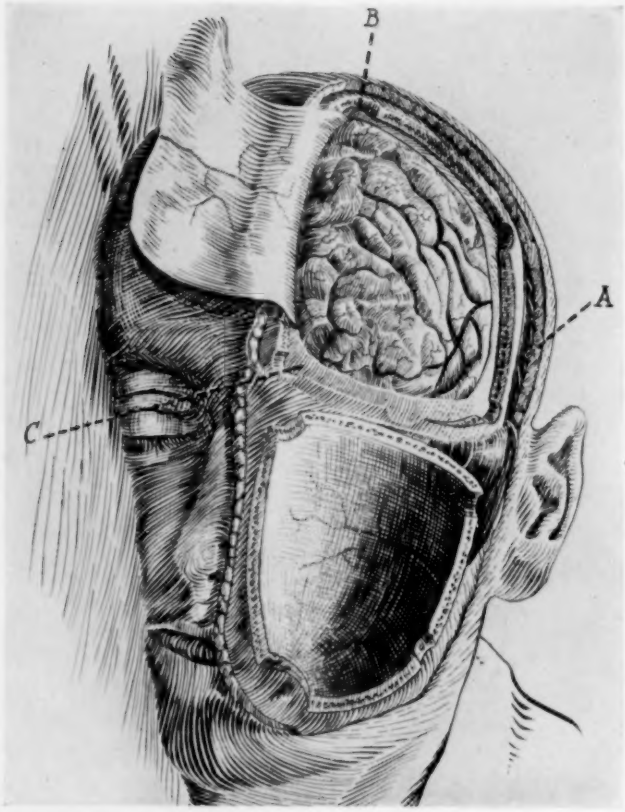

FIG. 2.—The frontal lobe exposed.

not completely removed or where only an exploration was done without tumor removal.

The operation here described fulfills all these conditions. There are a few points in these procedures that need comment.

The anterior limb of the incision at letter A, Fig. 1, must be exactly in the median line so that the function of the frontalis muscles will not be interfered with. When the incision AD reaches the hair line it should swing to one side of the midline, so that the bone can more easily be cut to one side of the longitudinal sinus. There are three holes made with a perforator and burr at A, B, and C. At D I have found it wiser to make a somewhat larger opening with the ordinary crown trephine, so that an instrument can be passed from D to A to separate the longitudinal sinus in case one wishes to get close up to the falx. In such a case the incision AD, after reaching the hair, would swing to the right of the sinus, instead of to the left as in the patient shown in Fig. 1. This was not necessary in the patient shown in Fig. 1, because his lesion, a depressed fracture due to a bullet imbedded in the frontal lobe, lay some dis-

FIG. 3.—Field of operation for exposing both frontal lobes—frontal view.

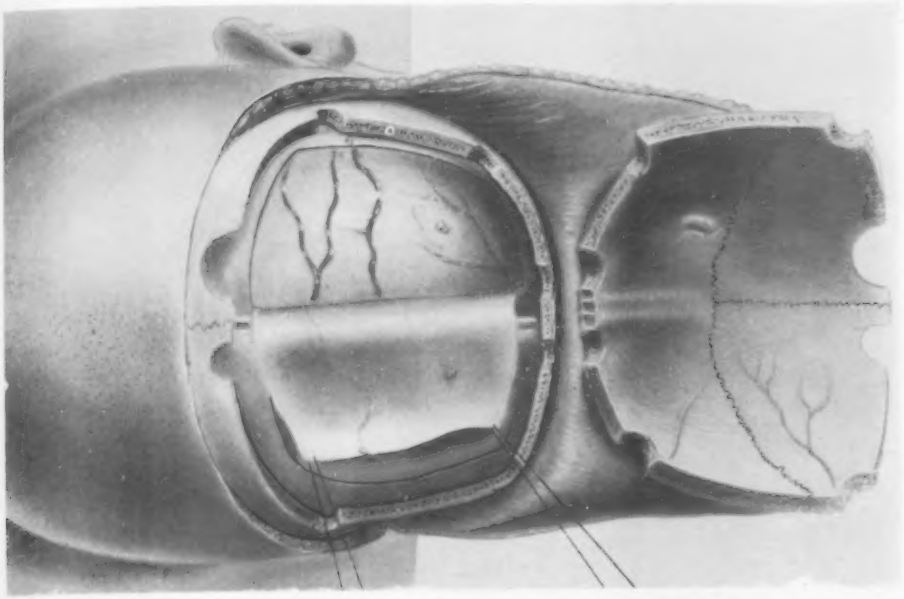

FIG. 5.—Both frontal lobes exposed.

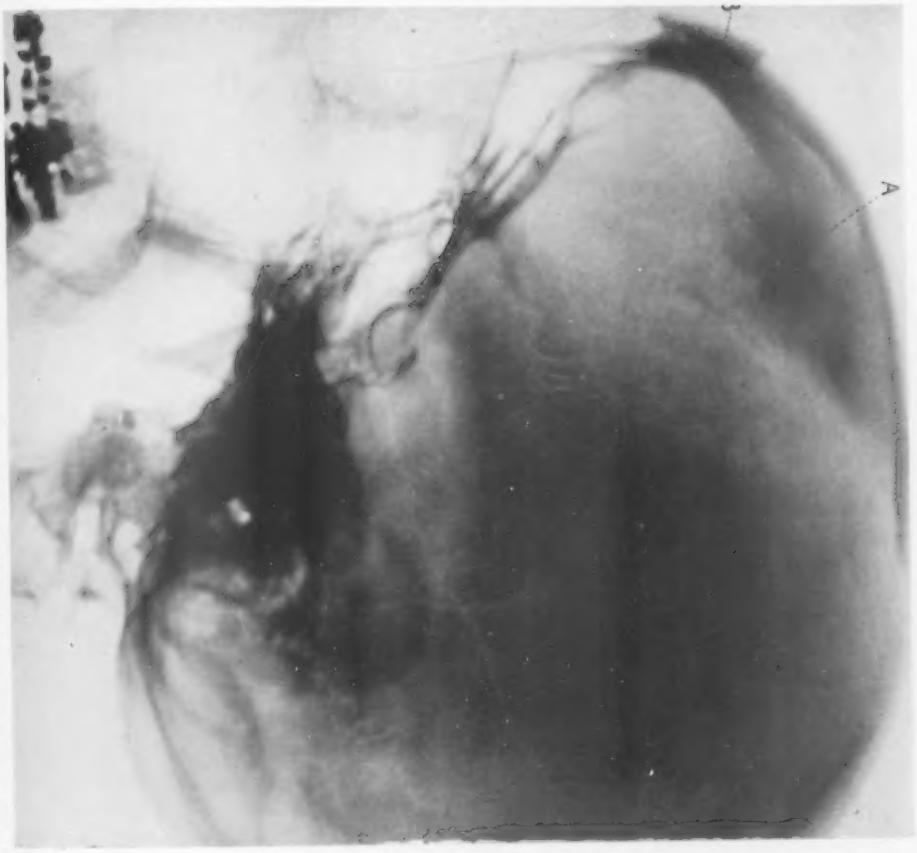

FIG. 6.—A is the calcified shadow. B is the lead marker placed exactly in the middle line and a postero-anterior picture indicated that the shadow A extended right up to the median line.

tance from the median line. At C the incision passes through the temporal muscle and at that point if desired a decompression can be done. This is well shown at A, Fig. 2. All sides of the flap are cut with Gigli saws. One saw is passed from A to B and another from B to C, Figs. 1, 3 and 4, and left in place until the flap is turned back. It is unwise to attempt to cut from A to C, Fig. 1, with one saw, as the convexity of the skull at B would necessitate depressing the dura and underlying brain excessively.

When a bilateral exposure is contemplated as in Figs. 3 and 4, two openings have to be made with a perforator at A, one on each side of the sinus, and also two openings at D, Fig. 4. Fig. 5 represents condition found in case shown in Figs. 3 and 4. Patient showed a large calcified shadow close to median line, Fig. 6. Patient's symptoms in conjunction with the X-ray shadow led me to make a preoperative diagnosis of an endothelioma growing from the falx and therefore a bilateral exposure seemed desirable. At operation I found the calcification to be embedded in the frontal lobe and associated with an extensive old traumatic arachnoiditis. Both these patients were operated under local anæsthesia and experienced no more discomfort than with any osteoplastic flap.

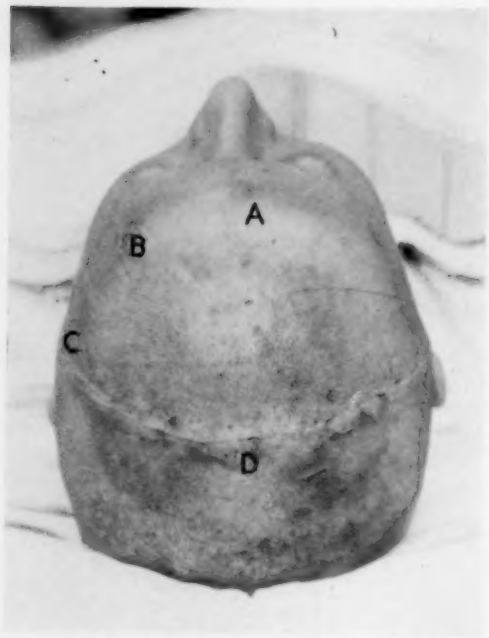

FIG. 4.—Field of operation for exposing both frontal lobes, viewed from above.

This type of flap might well be used for an approach to the pituitary for those who are in the habit of using the frontal approach. Personally, I have not tried it, as I have made use of the lateral approach described by Heuer and Adson.

SOME ASPECTS OF THE DIAGNOSIS AND SURGICAL TREATMENT OF TUMORS OF THE SPINAL CORD *

WITH A STUDY OF THE END RESULTS IN A SERIES OF 119 OPERATIONS

By Charles A. Elsberg, M.D.

of New York, N.Y.

With the advances in our knowledge of the location and functions of the different cell groups and fibre tracts in the spinal cord, there has come a better understanding of the symptoms and signs of slowly increasing cord pressure, and the possibility of a finer differentiation between the disturbances caused by spinal cord tumors and those which result from intrinsic disease of the cord.

Manometric studies of the pressure of the spinal fluid and the investigation of the physical, histological and chemical changes which occur in the fluid when the subarachnoid space has become blocked by an expanding new growth have added much to our knowledge, advances which are due especially to the studies of Froin,[1] Mestrezat,[2] and Sicard and Foix [3] in France, of Raven [4] and Queckenstedt [5] in Germany, and of Ayer [6] and his co-workers, of Stookey [7] in our clinic, and of others in this country.

Much progress has also been made in our understanding of the mechanical effects of tumors within the spinal canal and of the manner in which nerve roots and fibre tracts are involved by a slowly increasing pressure.

From the progression of the symptoms and the objective signs of disturbed function, we are now able, in many instances, to say with certainty that an individual has a spinal cord tumor, and it is possible to diagnosticate not only the level at which the spinal cord is compressed, but also the side of the cord—whether anterior, posterior or lateral—upon which the expanding lesion is exerting its pressure.

Rarely, however, does the patient first seek out the neurological expert on account of his symptoms; more often he consults the general practitioner, and not so rarely the general surgeon on account of pain in one or other part of the body.

Pain in Spinal Cord Tumors.—Pain referred to the back, to the chest, to the abdomen or the extremities is very frequent in spinal cord tumors—occurring in my series of 115 cases in about two-thirds of the patients with extramedullary and extradural growths, and in less than one-sixth of the patients with growths within the substance of the cord. In high cervical tumors, the pain may be felt in the suboccipital region or in the nape of the neck, on one or the other side. The pain in the neck from a tumor which compresses the cervical spinal cord may be very severe, and may be so much

* Read † the combined meeting of the Philadelphia and New York Surgical Societies, February 25, 1925. No reference is made, in this paper, to primary or secondary malignant disease of the bony spine.

increased by movement that the head and cervical spine are held absolutely rigid and the patient presents the clinical picture of an affection of the cervical vertebræ.

Pain due to involvement of the upper thoracic sensory roots is often referred to the axilla, underneath the scapula, or to an intercostal space, and may simulate a disease within the thoracic cavity, while pain due to pressure of a tumor on the lower thoracic sensory roots is often referred to some part of the abdomen, and not so rarely to one or the other hip-joint. Pain in the bladder or rectum is frequent in tumors of the lower portions of the spinal cord, and pain which has the characteristics of a sciatica is often seen when the roots of the cauda equina are affected.

Pain which is made worse by movement may be, and often is, the earliest symptom of a spinal cord tumor; it may appear suddenly and persist for a long period, or may occur in attacks during the progress of the disease. It is frequently made worse by forced expiratory movements such as occur in coughing and sneezing, and not rarely the parts of the body to which the pain is referred are sensitive to pressure.

Upon careful examination, it is possible in many instances to determine that an apparent tenderness to deep pressure is really a hyperalgesia of the skin, but in some patients deep pressure over the region of subjective pain is actually painful. This is especially the case when the pain is referred to the back, because in many cases of cord tumor, one or more vertebral spines are found to be tender.

Remissions are not unusual; the periods of freedom from pain may last for weeks, months or years. For many months pain may be the only symptom of a cord tumor and the recognition that it is a root symptom may for a long period be difficult or impossible.

It is not surprising, therefore, with these difficulties in the interpretation of the symptom, that many patients are treated for a long period for "neuralgia," and that before the patients' symptoms had become more advanced and they came under our observation, attempts had been made to afford relief by various operative or non-operative methods. The following experiences are briefly cited in order to emphasize the difficulties encountered and the errors that may be made.

Pain in the back was complained of as a prominent symptom in 28 patients of my series of cord tumors, and on account of changes in the vertebræ found by X-ray examination, not a few of the patients had been suspected of having Pott's disease, and had worn plaster cuirasses for a shorter or a longer period.

In two of the patients the pain in the back had appeared a few months after an attack of typhoid fever, and both patients had been treated for "typhoid spine."

Pain in and around one hip-joint had persisted for a long period in three of our patients, which had led to a kidney operation in one instance, and to

immobilization of the hip in plaster-of-Paris for suspected tuberculosis in another.

Two patients had suffered from recurrent attacks of pain in the right hypochondrium, and one from gastric disturbances with pain and sensitiveness

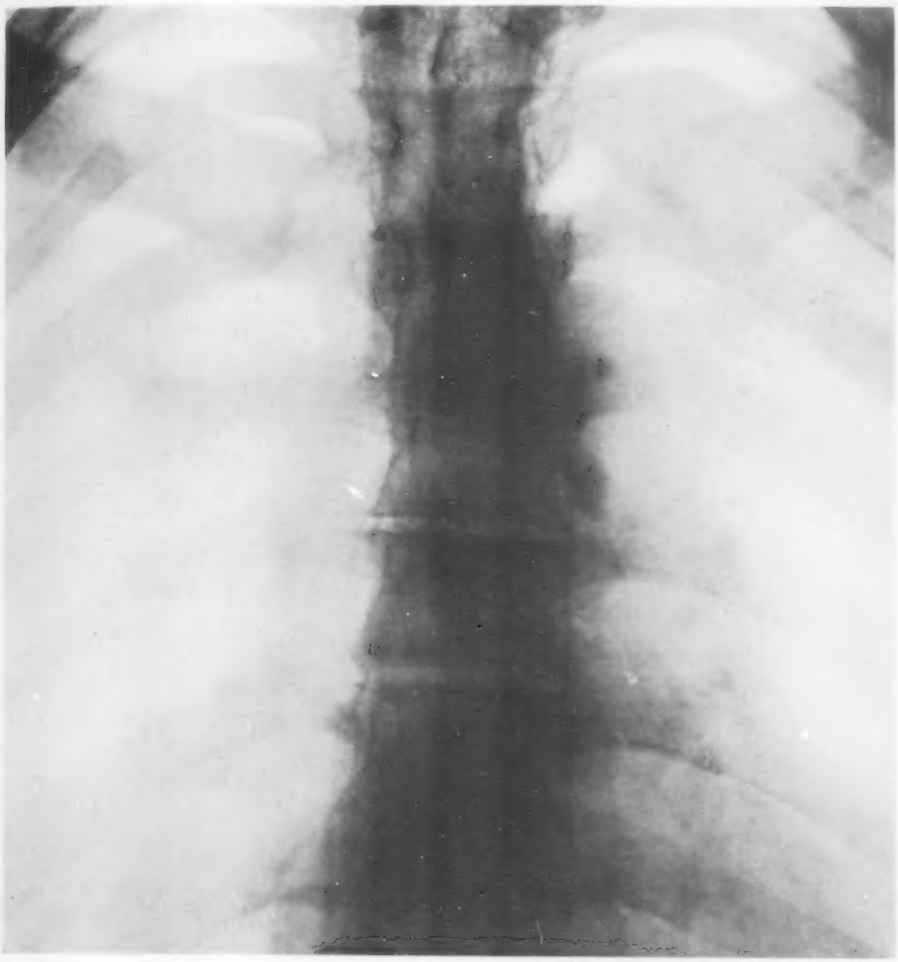

FIG. 1.—Showing the X-ray appearances in a patient with a spinal cord tumor, who had Pott's disease many years before at the same level as the tumor.

in the left hypochondrium; one of these had been operated upon for gall-stones and another for suspected gastric ulcer.

Pain in one or other part of the abdomen had been complained of by seven patients, and the persistence of the pain without other symptoms and signs had led, in one instance, to a laparotomy with removal of one ovary; in another, to a hysterectomy; in a third to a cholecystectomy; in a fourth to an exploratory operation for gastric ulcer, and in a fifth to the removal of the appendix.

In many of the instances cited, the errors were perhaps unavoidable, but

all teach the lesson that the possibility of a spinal nerve root origin for a localized pain in the chest, abdomen, or extremities should always be kept in mind—even in the absence of any confirmatory signs or symptoms.

The X-ray Changes in the Vertebræ in Spinal Cord Tumors.—While a localized increase of pressure within the cranial cavity often causes very definite changes in the cranial bones visible on the X-ray plate, this does not seem to be the case in the vertebræ, and in the majority of instances, an expanding lesion primarily within the spinal canal does not give evidence of its presence in the röntgenogram.

Arthritic changes at the level of the growth occur, however, with some frequency and possibly these changes, usually called "arthritis" or "spondylitis" by the röntgenographer, may in the future be shown to have some direct relation to the increased intraspinal pressure.

In our patients with intradural extramedullary tumors, the X-ray was normal in most instances. Thus, of 71 cases, the X-ray revealed normal conditions in 56; in 10 instances, there were the changes of arthritis or spondylitis at and below the level of the new growth; in one patient, the vertebræ above and in three, the vertebræ below the level of the tumor, showed some spondylitis on the X-ray plate; in one patient there was a defect in the lower lumbar and upper sacral vertebræ (spina bifida occulta) overlying the new growth.

Two of our patients had had, at some previous time, a tubercular disease of the bony spine, and the röntgenograms showed the characteristic changes of an old vertebral disease. In one of the patients, the changes in the vertebræ were at the actual level of the growth, so that the differentiation between Pott's disease and a spinal tumor was difficult (Fig. 1). The second patient had a marked kyphoscoliosis and the X-ray evidence of old bone disease at a somewhat higher level than that of the cord tumor.

In the extradural tumors, the X-rays showed nothing abnormal in 15, while there was a definite loss of substance from bone erosion in one patient, a fusion of the two vertebral bodies at the level of the growth in another, and a calcareous tumor in a third (Figs. 2 and 3).

In 13 patients with verified intramedullary tumors, there were no X-ray evidences of any kind of change in the vertebræ.

These figures are of some interest, because *a priori*, one should have expected a larger proportion of the extradural growths to have caused bone changes visible in the X-ray films.

Whenever there is found on the X-ray plate a change not of a spondylitic character, it is probable that the growth is not a true spinal neoplasm, but rather primary or secondary malignant or tubercular disease of the bone.

The Differential Diagnosis between Spinal Cord Tumor and Secondary Extradural Malignant Disease.—When an individual who has or has had malignant disease in any part of the body, begins to complain of persistent and severe pain in some part of the back or in one of the extremities, the diagnosis of a secondary growth in or about the vertebræ is probable. When spinal

symptoms appear which progress rapidly and cause a flaccid paraplegia within a few days, the diagnosis of metastatic disease of the vertebræ is certain.

When there is no previous history or evidence of malignant disease, of syphilis, of tuberculosis, or of trauma, the development of a flaccid paraplegia within a few days after a period of pain, is always indicative of the rapidly

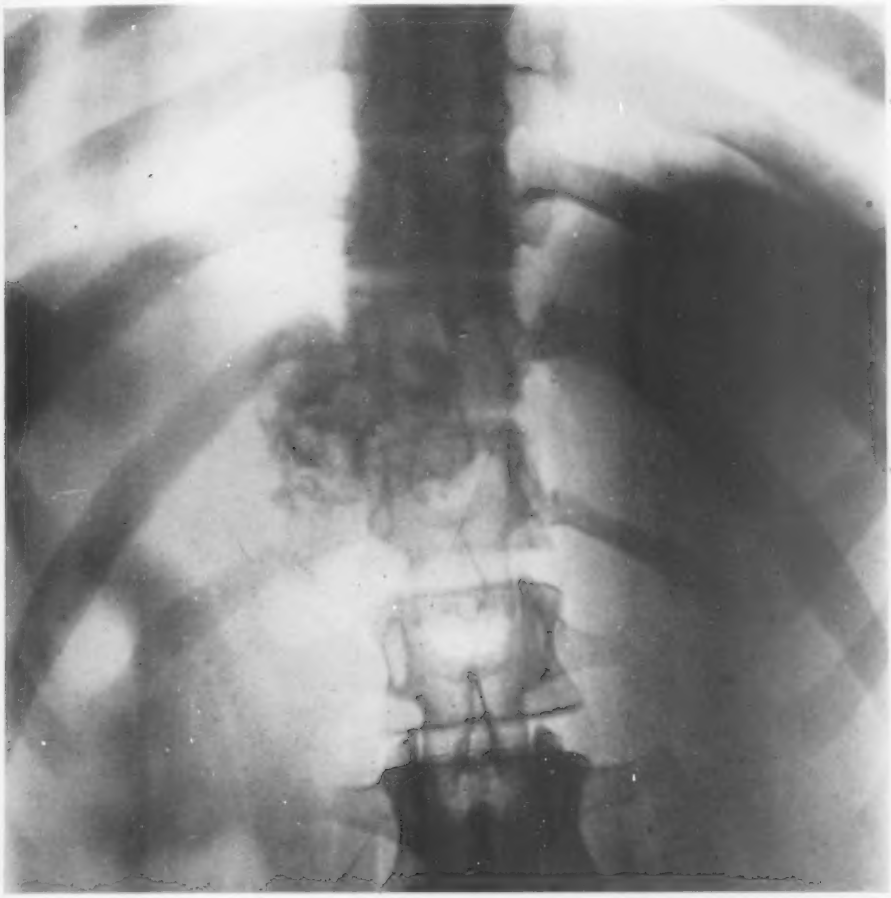

FIG. 2.—An extradural chondro-sarcoma of the eleventh and twelfth thoracic vertebræ before operation.

advancing cord lesion that results from an inflammatory process or from malignant disease.

In some instances, however, the symptoms and signs of malignant vertebral or paravertebral disease progress more slowly; there may be root pain for a considerable period, followed by a slowly advancing spastic paralysis with sensory disturbances, and in these patients, the differentiation from true cord tumor may be difficult.

The course of extradural malignant disease is generally shorter than that of a cord tumor, and there is often a loss of flesh out of proportion to the

length of time that the patient has been ill. The pain complained of may be over the area of distribution of a spinal root, but more often, the pain is strictly localized to some part of the back or to one of the large joints such as the shoulder or the hip. The patients often complain of pain which runs from the spine directly forward to the anterior part of the body, and state that the pain is made worse by the slightest movement of the affected part.

Spasticity and weakness of the limbs usually progress rapidly and very often both lower limbs are affected at the same time. The X-ray may show early erosion of one or more vertebral bodies, but when the disease has begun in the muscles and has secondarily invaded the arches of the vertebræ, there may be little if any changes from the normal seen in the röntgenogram.

The sudden development of a flaccid paraplegia—perhaps overnight—is very characteristic of malignant disease, and rarely occurs in true spinal cord tumors. Occasionally in patients with extramedullary cord tumors lumbar puncture and withdrawal of fluid is followed by an exaggeration of all of the signs of compression and unless the patient is operated upon without delay, the signs of a complete transverse cord lesion may rapidly appear. In several patients of our series, the history obtained was that a flaccid paraplegia had followed a lumbar puncture. All in all, however, a flaccid paraplegia is rare in true spinal cord growths—occurring only in the very terminal stage of spinal compression by a neoplasm and of course in tumors between the roots of the cauda equina.

In every patient with the signs of cord compression in whom a neoplasm is suspected but in whom the symptoms and signs of a level cord lesion has been of only a few months' duration, extradural malignant disease should be suspected, and a careful search should be made for a primary lesion in some other part of the body. The urine should be examined for the Bence-Jones bodies, in order to exclude multiple myeloma. Metastatic disease in and around the spine is most often due to primary malignant disease of the breast, uterus, thyroid or prostate gland. It is often, also secondary to or a direct extension of malignant disease within the thoracic cavity. As we have pointed out,[8] the spinous processes in malignant bone disease that are sensitive to pressure are often those at the vertebral level of the disease, while in true cord tumors, the sensitive spines are somewhat lower.

The Frequency and the Prevention of Errors in the Diagnosis of Spinal Cord Tumor.—We had, for many years, divided our operations for cord tumor into three groups: (1) those in which an unqualified pre-operative diagnosis of tumor was made; (2) those in which the tumor was considered probable, although not certain; (3) those in which a tumor was considered possible but not probable, and in which the operation was an exploratory one.

In the patients of the first group, errors in diagnosis were infrequent, while in those of the second group (probable cord tumor) a new growth was often exposed but in not a few cases, the diagnosis was proven erroneous. In the third group, finally, no tumor was ever found.

Since we have paid more attention to the results of the manometric tests

for partial or complete spinal block, we have altered our classification of the patients, and in the large majority of instances for a positive diagnosis of cord tumor, we now demand not only a good history and clear physical signs, but also evidence that there is a complete or incomplete interference with the normal flow of the spinal fluid by the manometric tests.

The manometric studies of the spinal fluid that have been made in my

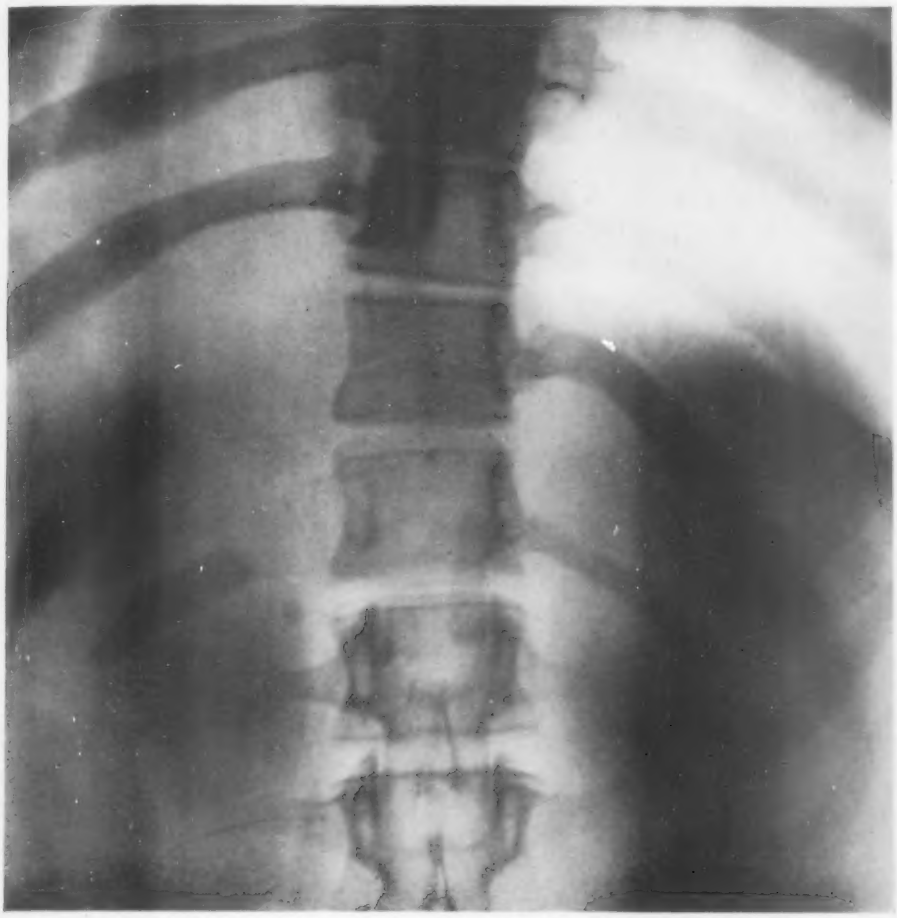

FIG. 3.—The result after the removal of the tumor and of parts of the eleventh and twelfth ribs.

clinic by Doctor Stookey have contributed greatly to improvement in our diagnosis and from the time that these careful studies have been made, errors in diagnosis have become less and less frequent.

The results of the studies of incomplete spinal block have been especially useful. Stookey has shown that a very slight interference in the outflow of the spinal fluid—small differences in the rapidity of the rise and fall of the column of fluid in the manometric tube, slight and momentary slowing or hesitation in the rise and fall of the fluid, changes in the level of the fluid upon the slightest compression of the jugular veins (touch compression of

Stookey) as well as upon deep compression of the veins (Queckenstedt test), etc.—all these changes have great insignificance for the demonstration of an incomplete blocking of the spinal subarachnoid space in early and slight cord compression. The manometric tests have also been of great value to us in the patients in whom the disease has run an atypical course and in whom the physical signs of cord compression were vague and ill-defined. In some of those patients, the positive results of the tests led us to operate and find the cord tumor, while in an increasingly large number of patients the entirely negative results of the tests have thrown the weight of evidence against the diagnosis of cord tumor and have thus prevented an exploratory operation.

A diagnosis of cord tumor should, of course, never be made from the results of the manometric tests alone, for a complete spinal block may be due also to inflammatory disease of the cord with adhesions between the pia and arachnoid, to intramedullary disease, or to a fracture-dislocation of the vertebræ, etc., and a partial spinal block may be caused by any of the conditions already mentioned and perhaps may occur with a marked spinal curvature. It is well to remember also that a patient with a cord tumor which is still small may give a typical early history of a slowly increasing spinal compression and signs which justify a strong suspicion that he has a tumor, before any evidence of the slightest degree of spinal block can be obtained by the manometric tests. While cases of this kind are possible, they are certainly rare. The manometric tests are of great value for the diagnosis of spinal cord tumor and if they are entirely negative, a diagnosis of cord tumor is rarely justifiable at that stage of its development, and it is probable that the signs of disturbed cord function will also be so indefinite that the further progress of the symptoms and signs will have to be awaited before a diagnosis of cord tumor can be made. At the present time I have two patients under observation who belong in this category.

In previously published papers I have called attention to the fact that in every patient in whom a compression by a spinal new growth is considered possible, a careful neurological examination should be made not only before the lumbar puncture, but also after spinal fluid has been withdrawn. Vague and indefinite level signs often become distinct after the lumbar puncture.

During the past few years, the number of instances in which operations were performed under the erroneous diagnosis of cord tumor has become much smaller, but in order to give a fair idea of our past experiences, I have included in the following figures, all of the cases in which, during the past six years, a laminectomy was performed under the diagnosis cord tumor or in which the operation was done in order to exclude compression of the cord by a new growth.

There were 116 patients who belonged in this category. In 97 of them, the pre-operative diagnosis was "spinal cord tumor" or "probably cord tumor," and in 81 the diagnosis was verified at the operating table. In 16 patients, however, no tumor was found and the diagnosis must have been an erroneous one.

In 19 other patients, we did not believe that the patient had a spinal new growth, but we did not feel that the diagnosis of tumor was absolutely excluded and therefore gave the patients the benefit of the doubt and did an exploratory operation. In not a single one of these nineteen cases was a tumor found!

In 35 of the 116 cases, therefore, no spinal tumor was demonstrated. In some of these 35 patients, gross pathological changes were observed when the cord was exposed, while in others, nothing abnormal was seen at the operation. Four patients suffered from a neuritis of the cauda equina, three from meningomyelitis with adhesions between the membranes, one from a unverified intramedullary lesion, one from varicose veins of the cord and eight from multiple sclerosis. In five cases, the cord was found to be small and atrophied, and in thirteen nothing abnormal was found at the operation and the nature of the disease remained unknown.

Recurrences After the Removal of Cord Tumors.—When an intradural tumor has been removed *in toto,* recurrences are rare. In my series, I have seen three instances. One was in a case of an extramedullary sarcoma, 2 x 1 centimetres in size, adherent to the dura at the sixth cervical segment, which was removed in one piece. Two years later, there was a recurrence of symptoms, and at the second operation, a tumor of the same size was removed together with a piece of dura. The operation was done four and a half years ago, and there has been no recurrence.

In a second patient, there were two recurrences of a neurofibroma at the sixth cervical segment. At each of the three operations upon this patient, a piece of dura was excised with the growth. Each recurrence took place after an interval of about two years.

In a third case, operated upon eight months ago, an extramedullary tumor had been removed from the sixth thoracic segment by another surgeon. About two years later I removed another growth—an endothelioma—together with a piece of dura from the same location, since which there has been no recurrence.

Among the extradural tumors which could be completely removed, there has been one recurrence. This occurred in a patient from whom I had removed an extradural fibrosarcoma from the seventh cervical level in 1912. She remained well for eight years, and then had a recurrence at the same level for which she was operated upon by Dr. Emmet Rixford, of San Francisco.

There have been, therefore, in my own series of spinal tumor operations, three recurrences, or 2.6 per cent., in patients in whom the records stated that growth had been entirely removed at the first operation.

In the first of the four patients, a recurrence might not have taken place if a piece of dura had been excised with the growth, but in the second case, I am at a loss to explain the recurrent neurofibromata. The late recurrence in the fourth patient (with an extradural fibrosarcoma) is of interest.

There are only a few reports of recurrences of intradural extramedullary

tumors in the literature—a case of A. V. Lambert,[9] one of J. B. Murphy,[10] and one mentioned by Frazier and Spiller.[11]

In every instance in which a tumor is found to be adherent to the inner surface of the dura, it should be treated in the same way as we treat the intracranial dural growths—by excision of the piece of dura to which the growth is adherent. If the defect in the dura is so large that it can not be closed by suture, the exposed cord should either be covered by a piece of Cargile membrane, or a fascia transplant should be performed.

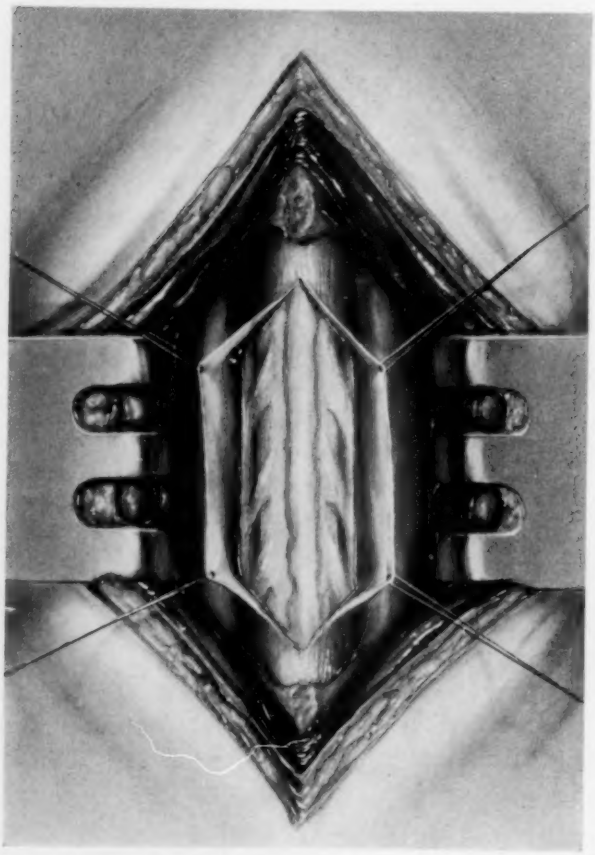

FIG. 4.—The spinal cord exposed and seen through the unopened arachnoid.

Some Technical Features of the Operation of Laminectomy and Removal of Cord Tumors.—"Though I may not live long enough," said Astley Cooper[12] just about one hundred years ago, "to see the operation of laminectomy frequently performed, I have no doubt that it will be occasionally performed with success." "We must submit to hear many strange proposals for the improvement of our profession in the present day from young men ambitious of notice," responded Charles Bell,[13] "but that a man of Sir Astley's years and station should talk as he has done before students, and give them his authority for laying a patient upon his belly, and by incisions laying bare the bones of the spine, breaking up these bones, and exposing the spinal marrow itself, exceeds all belief."

Tempora mutantur et nos mutamur in illis. The indications for the operation of laminectomy, and the technic of the exposure and removal of spinous processes and laminæ is now so well understood, that a description of the various steps of the procedure is superfluous. Whether the surgeon makes the cutaneous incision in the midline, over the tips of the spinous processes, or to one side or the other, is of little importance. Flap operations, as they are more complicated and have only theoretical advantages, have been almost

entirely discarded. Nor does it make a great deal of difference whether the spinous processes are first removed with rongeur forceps and the laminæ bitten away with smaller rongeurs, or if one or more laminæ are first perforated or divided with a drill or burr. My own preference is to bite away the spinous processes with large rongeur forceps, and the laminæ with smaller rongeurs, because the use of a burr is a more complicated method and requires more time than the simpler procedure in which the bone is removed with rongeur forceps. This part of the operation requires little time; in most of our patients, the arches of three vertebræ had been removed within ten to thirty minutes from the time of the skin incision.

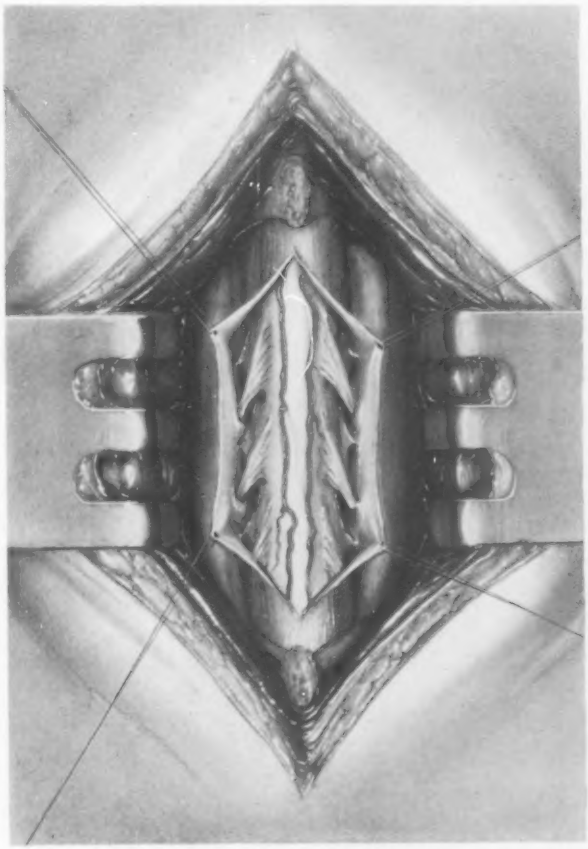

FIG. 5.—The cord exposed after incision of the arachnoid and escape of the subarachnoid fluid.

When the dura is incised, the attempt should be made to leave the arachnoid sac unopened, so that that membrane can be thoroughly exposed and pathological changes in it noted. The normal arachnoid is transparent and is not adherent to the dura, and the cord covered by the posterior spinal vessels can be seen through the transparent membrane and the subarachnoid fluid (Figs. 4 and 5). The respiratory and cardiac pulsations of the fluid and of the cord can often be well seen through the unopened arachnoid. Another advantage is that the cord will be protected from any little blood in the operative field, and if in rare instances the surgeon has to deal with a growth which is outside of the arachnoid sac and is adherent to the inner surface of the dura, it may be possible to extirpate the growth without opening the arachnoid.

The primary opening in the arachnoid should be small—only large enough to permit the escape of the spinal fluid. If the growth is not seen within the area exposed, and congested and tortuous posterior spinal veins make it probable that the tumor is a little higher, a probe or soft catheter is carefully

passed upwards in the subdural space, and the obstruction searched for. The searcher should first be passed upwards over the midline of the cord, and if nothing is found, should be passed upwards more laterally.

On the posterior surface of the cord, this exploration is easily made, but when the subdural space in front of the cord is to be explored with the probe, it is advisable to grasp a slip of the dentate ligament with mosquito forceps, to divide it at its dural attachment, to raise and rotate the cord by traction on the divided slip of dentate ligament (Fig. 6) and only then to pass the searcher upwards. The same procedure should be followed when the exploration is made in a downward direction.

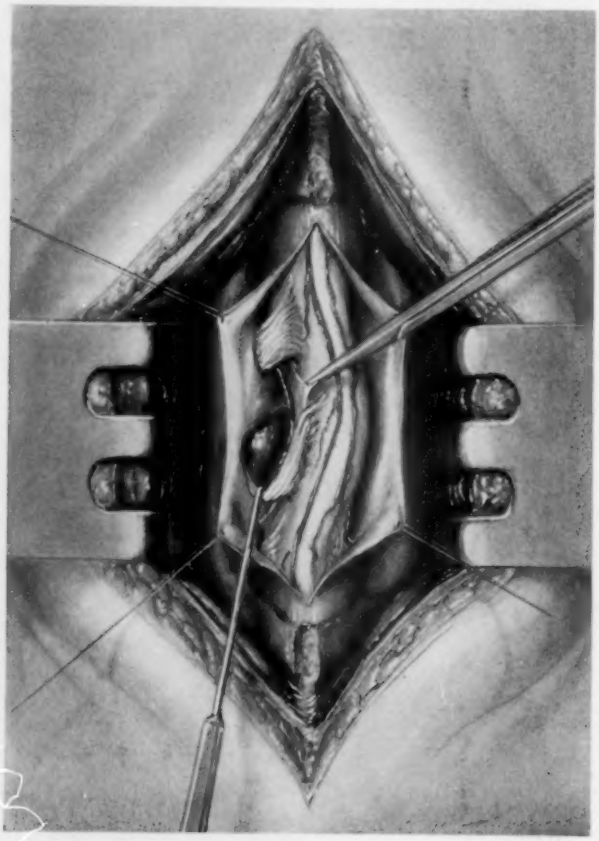

FIG. 6.—Showing the manner of rotation of the cord by traction from a divided slip of the dentate ligament in order to expose a ventro-lateral tumor. Note that the posterior root over the growth is retracted downwards by a small hook.

The tip of the exploring probe may be arrested from one of several causes, by impinging upon a nerve root or a slip of the dentate ligament, by the curve of the vertebral column, by an arachnoid adhesion or by one of the calcareous plaques often found on the outer surface of that membrane, or, finally, by the tumor itself. While we have sometimes wrongly interpreted an obstruction felt, with the exploring probe, the elastic resistance due to tumor can generally be recognized.

If the cord level of the compression has been correctly diagnosticated and the proper spines and laminæ have been removed, the tumor is generally found in the exposed area and this exploration is unnecessary. Occasionally, however, a small ventral or ventro-lateral growth within the exposed area of the cord will escape detection unless the ventral subdural space is explored with a probe. In a patient recently operated upon, a small ventro-lateral tumor which lay in the middle of the exposed area, and which has caused no backward dislocation of the cord, was found only when the subdural space in front of the cord was explored with the probe.

The removal of growths on the dorsal or dorso-lateral aspects of the cord presents no especial difficulty, but the exposure and extirpation of a ventrally situated neoplasm is always a more complicated procedure. In the exposure of ventral growths, the cord has to be rotated and drawn to one side by traction on one or two divided slips of the dentate ligament. Even when in addition one or several nerve roots have been divided to permit of further dislocation of the cord, the exposure obtained may not be an ideal one. It may be necessary gently to pull the cord away from the growth, but this procedure—no matter if done with the most meticulous care—causes a certain amount of trauma to an already changed cord, and may be followed by more marked disturbances in the affected part of the cord. The attempt should always be made to do as wide a laminectomy as possible and to reduce to a minimum the amount of handling of the cord. In a patient recently operated upon the spinal canal was very small, and so much dislocation of the cord was necessary in order to even partly expose a median ventral growth, that only fragments could be removed. In spite of great care in the manipulation necessary to control a brisk hemorrhage from the tumor, the patient presented —after the operation—the signs of a complete transverse lesion of the cord. This was the most difficult extramedullary tumor operation that I have performed, and presented many problems of technic.

In secondary operations the technic has to be somewhat modified. The scar tissue which extends down to, and includes the dura, may make it difficult to determine when the plane of the dura has been reached, and as a result the division of the subcutaneous tissue has to be made with especial care. In some cases the meninges are adherent to each other, and injury to the spinal cord can only be avoided by a slow and careful dissection. In the operations for recurrent symptoms that I have performed, I have found that the manipulations are much simplified in the following manner. After the incision through the skin and part of the muscle planes which overlie the arches that had been removed at the first operation has been made, the skin incision is extended downwards, and the next spinous process and laminæ are removed. This exposes a normal area of the dura, and this dura is a useful guide for the depth to which the tissues are to be divided, and for the incision in the dura that has to be made.

The Operative Mortality of Laminectomy for Spinal Cord Tumors.—Up to November, 1924, there have been performed in my clinic 119 laminectomies for spinal cord tumor, and 270 laminectomies for other affections. Thus of the total of 389 spinal operations, 119, or 30 per cent., were performed upon 114 patients for verified new growths within the spinal canal.

The *operative mortality* of the tumor cases can be seen in the following table:

Total number of operations	120	
For extramedullary tumors	106,	10 deaths = 9.5%
For intramedullary tumors	14,	3 deaths = 21%
The extramedullary tumor operations were as follows:		
Intradural extramedullary tumors	69,	5 deaths = 7.3%

Tumors of conus and cauda equina ..... 12, 3 deaths = 25%
Extradural tumors ..... 25, 2 deaths = 8%

As the following tables show, the operative mortality is much higher in the patients in whom the tumor could not at all or could only be partially removed. These were: tumor of the conus and cauda equina (1 case), large intradural malignant growth (1 case), intramedullary infiltrating growth in the upper cervical cord (2 cases), extradural sarcoma (1 case).

Thus of the 120 operations:

The tumor was removed in 95, or in 80 per cent.

The tumor was only partially removed or was irremovable in 22, or in 18 per cent.

The tumor was not found at the first operation in 3, or in 2 per cent.

In the 95 operations with complete removal of the tumor, there were 8 operative fatalities, or 8.4 per cent.

In the 22 operations in which the tumor was partially or not removed, there were 5 operative fatalities, or 23 per cent.

These figures show, as one would expect, that fatalities from the operation occur more often when the tumor is found to be irremovable, or when only partial extirpation is possible.

The operative fatalities in the patients in whom the tumor was removed, mostly occurred many years ago, and were in some instances due to causes only indirectly connected with the operative procedure. The causes of death in these patients were the following: One from respiratory failure after the removal of a high cervical intramedullary growth (1910); two of post-operative pneumonia, one after nineteen days in a patient seventy years of age (1915), and one a very stout patient (1918); one from infection (1916); one from shock after the removal of a large extradural growth secondary to a mediastinal ganglion neuroma in a child of three years (1916); one of diabetes in diabetic coma (1917); one from nephritis and uræmia (1918); one from shock after the fragmentary removal of a large tumor of the conus and cauda equina (1918).

A fair idea of the dangers of the operation can be obtained from the statement that in the last 58 patients subjected to operation, there were three operative deaths—one in a case of partial removal of a large intradural and a second of an extradural sarcoma in the upper thoracic region of the cord, and the third in a case of intramedullary spongioblastoma of the upper three cervical segments which infiltrated, but had not caused any enlargement of the upper cervical cord and which was found only at the post-mortem examination.

The End Results After Operations for Spinal Cord Tumor.—In making a study of the end results after operations for spinal cord tumor, the patients must be divided into two groups: A, those in whom the growth was removed, and B, those in whom radical extirpation was impossible.

A. *End Results After Complete Removal of Tumor.*—Total number of patients, 93. Extramedullary tumors, 74. Extradural tumors, 16. Intramedullary tumors, 3.

Of these 93 patients, 40 were well and free from any disturbances and 27 were greatly improved, so that they were able to return to their occupation,

although some disturbances such as weakness of a limb, areas of disturbed sensation, etc., remained. These 67 patients, 72 per cent. of the total, can be considered as satisfactorily relieved of their symptoms. In 11 patients, or 11 per cent., there was little or no improvement after the complete removal of the growth; most of these patients were operated upon when they were in a very advanced stage of their disease. In several, spastic paraplegia had existed for from four to six years, and in several motor and sensory paralysis was complete, and the cutaneous and tendon reflexes had disappeared—an evidence that the lesion of the cord was a very advanced one.

Of the 67 patients above mentioned, who have remained well or greatly improved, the operation was performed 7–15 years ago in 21 patients; 3–6 years ago in 17 patients; 1–2 years ago in 19 patients; less than one year ago in 10 patients.

Three patients died, about two years after the removal of the tumor from other causes; three patients had a recurrence of the growth, seven patients died at periods from one to eight months after the operation from a disease (cystitis, pyelonephritis, other tumors in v. Recklinghausen's disease, etc.), directly traceable to the cord compression from which they had suffered, and the final results in five patients are unknown.

These end results are summarized as follows: Total number of patients, 93. Operative fatalities, 8. Well, or nearly well, 67 = 72 per cent. Little or no improvement but alive 1–9 years, 5 = 5.3 per cent. More or less improvement, but death after 1–8 months from a complication of the spinal lesion, 5 = 5.3 per cent. Recurrences, removed at a second operation, 3 = 3. per cent. End result unknown, 5 = 5.3 per cent.

The End Results After Incomplete Removal of the Growth or When the Growth is Irremovable.—In these patients, the final results are mostly unsatisfactory, and many of the patients succumb within a period of a few months or one to two years from the advancing cord involvement.

With surprising frequency, however, after only a partial removal of the growth, either due to the decompressive effect of the operation, the slow increase of size of the neoplasm, or the partial extrusion of the growth if intramedullary, the spinal symptoms improve very much after the surgical interference so that the patients recover a great deal of power in the limbs. The improvement may persist for a considerable number of years. Thus one patient with a verified intramedullary growth almost completely recovered after a laminectomy and incision of the cord, so that he was able to return to work and to take active exercise, but the spinal symptoms recurred after two years and he was not improved by a second operation and succumbed a year later.

Three patients with irremovable growths remained alive for six, eight and ten years respectively. Two of these had intramedullary gliomas, and the third is still alive with a spastic paraplegia ten years after an operation for an intramedullary perithelioma. In the latter patient, a second operation

was performed after six years and the spinal canal at the level exposed was found filled with the growth.

One patient, a physician, is still alive and able to be about, though suffering from marked disturbances in the upper extremities eight years after laminectomy and incision of the cord for an intramedullary glioma. A woman who was operated upon fourteen years ago for a large tumor of the conus and cauda equina, which was only partially removed, has borne two children since her operation and is still alive, although she now has a spastic gait and still has bladder disturbances. It is difficult to believe that this patient still has a tumor, and the suspicion is justifiable that the partial removal caused an interference with the blood supply of the remaining growth with a shrinking and perhaps disappearance of what had not been removed.

Few of the patients in whom radical removal of the tumor was impossible who received X-ray or radium therapy after the operation, survived for a longer period than others in whom radiotherapy was not used. The only unequivocal result from Röntgen therapy or radium that I have seen was in a patient with a metastatic spongioblastoma over the conus and cauda equina secondary to a growth in the posterior cranial fossa that had been removed by Doctor Cushing, in whom only a piece of the spinal tumor was removed at my operation. There was no improvement in the spinal symptoms after the laminectomy or after the radiotherapy. The patient succumbed after about one year with the signs of recurrence of the growth in the cerebellum and increased intracranial pressure for which a puncture of the corpus callosum was perforated by another surgeon. I was informed that at the post-mortem examination, all evidence of spinal growth had disappeared.

The end results in our patients with irremovable tumors are summarized in the following table:

The total number of patients	22	
Extramedullary tumor	7	
Extradural tumor	4	
Intramedullary tumor	11	
Operative fatalities	5†	
Died after 3 to 6 months	3	= 14%
Unimproved, but alive when last heard from (4–10 years)	3	= 14%
Unimproved, duration of life unknown	4	= 18%
Improved for 2 to 14 years	3	= 14%
Improved at first, but finally succumbed to their disease after 1–4 years	4	= 18%

The end results after operations for spinal cord tumor, when complete eradication of the growth is possible and the paralytic symptoms have not been of more than two or three years' duration, are very good. Seventy-two per cent. of the patients recover entirely or are so much improved that they can return to their work and become useful to themselves and to the community.

† Two patients with high cervical intramedullary growths; one patient with an intramedullary tumor in the mid-cervical cord; one patient with a large irremovable intradural sarcoma over the upper thoracic cord; one patient with an extradural sarcoma.

When, however, the growth cannot be entirely removed, either because it is within the substance of the cord and not well localized, or because of the extensive nature of the growth and its intimate relation to other structures, the results are, in the main, unsatisfactory. Some of these patients may be much benefited by the decompressive effect of the laminectomy and the partial removal of the growth, and may improve very much for a number of years.

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BONE TUMORS

ANALYSIS OF ONE THOUSAND CASES WITH SPECIAL REFERENCE TO LOCATION, AGE AND SEX

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The subject of bone oncology is at least as old as the Pyramids. Dr. G. Elliott Smith (A), during his nine years of research work in Egypt, found several mummies that showed well-preserved bone tumors. One of these victims of bone tumors was an architect of the Pyramids.

Much has been written and more has been said about tumors of the bones, but, unfortunately, the work has been limited to individual efforts. An effort is now being made by the Codman Registry of Bone Tumors, now sponsored by the American College of Surgeons, to crystallize the results of various investigators in this field. This work will undoubtedly revolutionize, or at least greatly modify the methods of diagnosis and treatment of tumors involving the osseous system as it is generally practiced in our time.

Bowley (B) has well said: "The proper function of statistics, indeed, is to enlarge our individual experience." King (C) states that: "Without a statistical study, most of our ideas are likely to be decidedly vague and indefinite." It was with the hope that an analysis of one thousand cases might yield some definite information upon the subject that this work was undertaken. Only three features will be considered in this paper; namely, location, age, and sex incidence.

The cases in this series have been collected from the Codman Registry of Bone Tumors, the Department of Pathology of Cornell University Medical College, the Memorial Hospital, New York City, and some from the literature.

The classification and nomenclature of bone tumors as adopted by the Committee of the American Pathological Society and the College of Surgeons, 1924, has been followed. The classification is as follows:

I. *Osteogenic tumors*—1. Benign. A. Exostosis. B. Osteoma. C. Chondroma. D. Fibroma. 2. *Malignant* (osteogenic sarcoma). A. Anatomic type: a. Medullary and subperiosteal. b. Periosteal. c. Sclerosing. d. Telangiectatic. B. *Undifferentiated sarcoma.*

II. *Periosteal fibrosarcoma.* III. *Giant-cell tumor.* IV. *Myeloma.* V. *Ewing's tumor* (probably endothelial myeloma). VI. *Angioma*. 1. *Benign.* 2. *Malignant* (angiosarcoma). VII. *Metastatic tumors.* VIII. *Inflammatory conditions that may simulate tumors:*

A. *Osteoperiostitis.* a. Traumatic. b. Syphilitic. c. Infectious.

B. *Osteitis fibrosa cystica.*

No cases have been included, however, of the class VIII type.

No attempt has been made to carry out the detail classification, as under Class I, 1 and 2, but these are grouped as benign osteogenic tumors, I, 1, and

osteogenic sarcoma, I, 2. This is in keeping with Ewing's [1] remarks on classifications, when he says: "Malignant tumors of bone-cells, although differing markedly in many features, are essentially one and the same disease, which may be designated as osteogenic sarcoma. . . . The attempt to classify these tumors as periosteal or medullary is, therefore, unsatisfactory, since most of them involve marrow cavity, shaft, and periosteum." The scheme used in Codman's Registry as to classification of mixed tumors appears to be very helpful; it is as follows:

"Osteochondroma includes	*Osteogenic sarcoma* includes
Osteoma	Osteo-sarcoma
Chondroma	Osteoid-sarcoma
Fibro-osteoma	Chondro-sarcoma
Fibro-chondroma	Myxo-chondro-sarcoma
Fibro-myxo-chondroma	Osteo-myxo-fibro-sarcoma
Fibro-osteo-myxo-chondroma	Fibro-myxo-chondro-osteo
Myxo-chondro-osteoma	Myxo-sarcoma, etc.
Myxoma, etc.	

These are descriptive terms, not often clinical entities. The Registrar considers them unnecessary and confusing."

In order that there may be no confusion as to what is meant by epiphysis and the end of a long bone, as used here, it may be well to state that to say that the end of a bone is involved does not necessarily mean that the epiphysis is implicated. Parsons [2] classifies epiphyses as (1) pressure epiphyses—weight bearing, (2) traction epiphyses—as greater and lesser trochanter, and (3) atavistic epiphyses—formed by the union of an element which formerly existed as a separate bone, as ischium and pubis. The pressure epiphyses are of greatest importance in this study.

The growth of the long bones take place at the ends, but on the diaphyseal side of the epiphyseal line. Keith [3] suggests that diaphyseal would be more correct than epiphyseal line. The epiphysis has no bone-forming function until the bone is full grown, when it, too, ossifies from an endochondral centre of ossification, except that on the articular surface. Keith [4] credits Ollier and later Macewen with finding that the epiphyseal disc has nothing to do with the growth of the shaft, but that the growth disc is a part of the diaphysis. The epiphysis serves to shelter the growing line of cartilage at the diaphyseal end of the long bone from friction and stress to which it would be exposed if situated directly on the articular end of the bone. As used in this classification, when a tumor involved less than one-third of the length of the bone from the end the location has been classed as proximal or distal end, if more than one-third was involved it has been classed as involving the shaft or whole bone. The epiphyses are not very thick and tumors confined to them are rarely seen.

I. *Osteogenic tumors:* 1. Benign: There were 35 cases in this class—12

males, 12 females; in 11 cases the sex and age were not given, except that all were adults. The age incidence, in decades, was:

1–10	1	31–40	3
11–20	4	41–50	7
21–30	5	51–60	4

The paired bones were about equally affected. Of the total of 35 cases, 22 involved long bones, and 12 of that number were in the femur, 3 in the proximal end, 1 in shaft, and 8 in distal end, also a favorite site for giant-cell tumors and osteogenic sarcomas. The remaining 23 were scattered as follows: Tibia, proximal end, 5; hand, phalanges, 3; humerus, proximal end, 2; fibula, proximal end, 2; ulna, distal end, 1; mandible, 2, and sternum, vertebræ dorsal, ilium, maxilla superior, ribs, foot-metatarsals, scapula, and skull, each 1.

The epiphyses were involved in 9 and free in 2 cases. No information as to the epiphyses was obtainable in the remaining cases. Twenty-one cases of this group were simple chondromas.

A. Keith [5] finds that bone laid down entirely in cartilage is relatively free from growth disorders, but that where it is formed in cartilage and comes to be covered by periosteum, as in a long bone, then, if the periosteum fails to develop, the cartilaginous portion is free to grow exuberantly and forms ecchondromas, exostosis, or an osteoma. He speaks of the secondary results from primary disorders of growth as *diaphyseal aclasia.*

Ewing [1] ascribes the cause of exostosis to an overgrowth of subperiosteal bone, and of chondromas he says: " Many of them are located at the growing ends of bones. . . . All these facts point to an origin from disturbances in development of the cartilaginous elements in the formation of bones and joints."

2. Malignant (osteogenic sarcoma). Under this both A, the anatomic type, *viz.:* a. Medullary and subperiosteal. b. Periosteal. c. Sclerosing. d. Telangiectatic, and B, the *undifferentiated sarcomas* are considered. There are 441 cases in this group. The sex was ascertained in 414 cases as follows: Male 242 (58.7 per cent.), and female 172 (41.3 per cent.). The age, in 376 cases, showed a wide variation, namely, from 2 to 77 years; both extremes were in the male. In 65 cases the exact age was unknown, although nearly all were adults, hence they are not included in the age table. In decades, the age incidence was:

Years	Male	Female
1–10	14	15
11–20	90	55
21–30	48	26
31–40	26	19
41–50	27	14
51–60	12	12
61–70	8	8
71–80	1	1
	226	150

The accompanying histogram, Fig. 1, illustrates, graphically, the comparative involvement in male and female. It is noteworthy that the number of cases in both sexes are about equal in both extremes of life, while the preponderance in the male is during the most active period of life. (This difference may be construed as a point in favor of the traumatic theory as an etiological factor.) The greatest number occurred during the second decade in both sexes. Meyerding[6] reports a series of 109 cases of sarcoma of the long bones. The sex incidence in his cases was: males 69, females 40.

Another interesting fact disclosed is that about 33 per cent. of osteogenic sarcomas in the male and 36 per cent. in the female occur after the thirtieth year. Gross[7] found that 32 per cent. of his series of 165 cases occurred after the thirtieth year. His series, however, included giant-cell tumors.

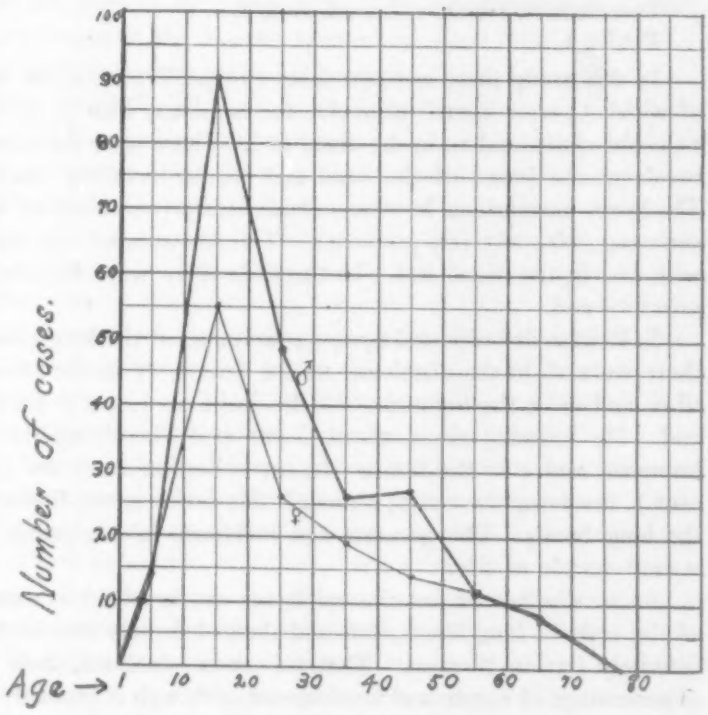

FIG. 1.—Osteogenic sarcomas.
Females, 150; ——— males, 226.

As to location of these tumors there is somewhat less difference in the two sexes. The difference is, in fact, so small that only the exceptions will be given in detail, whereas the general distribution of the tumors will be given collectively. The right and left of paired bones seem to suffer equally, so that a detailed description of that factor is hardly warranted.

The location in 441 cases was as follows:

Skull, 8.
Maxilla, 10.
Mandible, 5.
Vertebræ, dorsal 2, lumbar 4, sacral 2.
Ribs, female 5, male 1.
Sternum, 2.
Clavicle, 9.
Scapula, 14.

Humerus, male, proximal end, 19; shaft, 11; distal end, 8.
Humerus, female, proximal end, 11; shaft, 2; distal end, 1.
Humerus, two cases, sex unknown, 1 in proximal end, the other in distal end.
Radius, proximal end, 2; shaft, 2; distal end, 4.
Ulna, proximal end, 3; shaft, 1; distal end, 3.
Hand, bones of, 3.
Pelvis, male, 14; female, 4; sex unknown, 2.
Femur, proximal end, 15; shaft, 20; distal end, 139 (31 per cent.).
Tibia, proximal end, 69 (15 per cent.); shaft, 6; distal end, 8.
Fibula, proximal end, 13; shaft, 4; distal end, 4.
Foot, male, 6; female, 1; sex unknown, 1.
Patella, 1.

In this group there were 72 cases (16 per cent.), in the upper extremities of which 54 were found to involve the humerus, with 31 in the proximal end, 13 in the shaft, and 10 in the distal end. There were 82 cases (19 per cent.), involving the bones of the head and trunk, including scapula and clavicle. The lower extremities, however, claim nearly two-thirds of all the osteogenic sarcomas, *viz.*, 287 (65 per cent.). Of this number 174 were in the femur, with 162 in the distal end. In the tibia there were 83 cases with 69 in the proximal end.

S. Reinhardt [8] reported upon 54 sarcomas of the long bones. In his series there were 16 in the distal end of the femur, 17 in the proximal end of the tibia, and 11 in the humerus. Of his humerus cases, 7 were in the proximal end. He found 3 cases, about 6 per cent., involving the shaft; 2 in the humerus, and 1 in the fibula. In my collection there are 41 cases (9.3 per cent.), involving the shaft; although this series is not limited to sarcomas of the long bones. The greatest age incidence in his group was also in the second decade of life.

As to whether or not the epiphyses are involved in osteogenic sarcomas of the ends of long bones, I found them definitely involved in 72 cases and definitely free in 38 cases. That, of course, does not show the true number or percentage of epiphyseal involvement, although it probably fairly represents the relative frequency with which the epiphyses are or are not involved; namely, that approximately two-thirds of the cases involve the epiphyses. The medullary and subperiosteal, as well as the telangiectatic type, invade the epiphyses relatively early and frequently; whereas the sclerosing and periosteal variety assume a more lenient attitude towards the epiphyses, yet they, too, especially in advanced cases, may break through the epiphyseal line. The joint surface of the bone seems to offer considerable resistance to the progress of the tumor, nevertheless, there were several instances in which the joint was entered with invasion of the contiguous bones. This is usually a late complication.

There seems to be considerable variation in opinion as to whether or not the epiphyses are involved. Bland-Sutton [9] states that tumors developing in the ends of the long bones, especially in the young, will infiltrate the epiphyses, but rarely transgresses the articular cartilage. S. Reinhardt [8] found that only a few of his cases crossed the epiphyseal line, except in the late stages.

Ewing [1] calls attention to the resistance the epiphyseal line offers to the progress of these tumors.

There were 14 cases of central sarcomas in children, less than fifteen years old. Five were in girls, nine were in boys.

There were 16 instances of multiple sarcomas of the bones. It must not be inferred that that constitutes a percentage of multiple osteogenic sarcomas. It is seldom that a general röntgenological examination is made of the entire skeleton in cases of osteogenic sarcomas, so that it is difficult to estimate the frequency with which they occur. But it is to be remembered that when multiple tumors are found in the osseous system one must think of endotheliomas, myelomas, and metastatic epithelial tumors.

It is evident that practically all bones in the body are subject to osteogenic sarcoma. The first and second cervical vertebræ were not involved, the bones at the base of the skull were free. There were two sarcomas of the sternum in the female, and none in the male; only one case of sarcoma of the ribs in the male, as compared to five cases in the female. There was but one case of sarcoma of the patella. This was of the spindle-cell periosteal type. I have found but one other case in the literature, reported by Bland-Sutton,[9] as he speaks of a case of sarcoma of the patella, reported by Parker. While there are but 14 cases in the scapula in this series, Bland-Sutton [9] collected 20 or more cases involving this bone. All of the cases involving the hand were in the male, and five of the seven cases of the foot were in the male.

II. *Periosteal Fibrosarcoma.*—This is a less malignant tumor than the periosteal osteogenic sarcoma. Codman [10] gives a clear description as to what type of tumor this class was intended to include, when he says: "Clinically these are tumors which lie next to the bone, do not invade it, although they may cause absorption by pressure on the adjacent surface of the bone. It is grossly impossible to determine whether they arise in the outer layers of the periosteum or in the adjacent fascia or tendinous insertions. They appear to be less likely to metastasize than the osteogenic sarcomas. Röntgenologically they may show changes in the contour of the adjacent bones, even pushing the bones to one side or bending them, but histologically they show no tendency to form osteoid tissue, cartilage and bone. It is this that separates them from our class of periosteal osteogenic sarcomas, which presumably arise from the osteoblastic layer of the periosteum. Periosteal fibrosarcomas are not distinguishable histologically from fibrosarcomas of the fascia." In my entire collection I encountered only six cases with an unqualified diagnosis of periosteal fibrosarcoma. Of these four were in females: one, age, 33, right scapula; one, age 28, right scapula; one, age 26, right femur, distal end; one, age 17, humerus, distal end. Two were in males: one, age 38, left humerus, distal end; the other, age 14, shaft of right radius. (Five cases were well two or more years and the sixth case one year after treatment was instituted.)

III. *Giant-cell Tumor.*—There seems to be considerable confusion among writers upon the subject of oncology as to what constitutes a giant-cell tumor. It is not within the scope of this paper to discuss classification except to state

what form of tumor is included in each class. Giant-cell tumors were formerly classed as giant-cell sarcomas, but because they are essentially benign tumors the term sarcoma has wisely been discontinued in the modern classification of tumors by the Committee of the American Pathological Society and the College of Surgeons. Cases have been reported in the literature as giant-cell tumors, where the patient subsequently died with metastasis, and still they have been classed as giant-cell tumor, on the basis that sections revealed the presence of giant cells, without regard to what type of giant cells were present, and, seemingly, without giving due consideration to the rest of the histological picture. Many osteogenic sarcomas contain giant cells, but they are commonly of the malignant or sarcomatous type and not of the myeloplaxe type described by Nelaton,[11] 1860. (Those who wish to gain knowledge of giant-cell tumors will do well to read and study articles upon the subject by Ewing,[1] Bloodgood,[12] Stewart,[13] and Gross.[7])

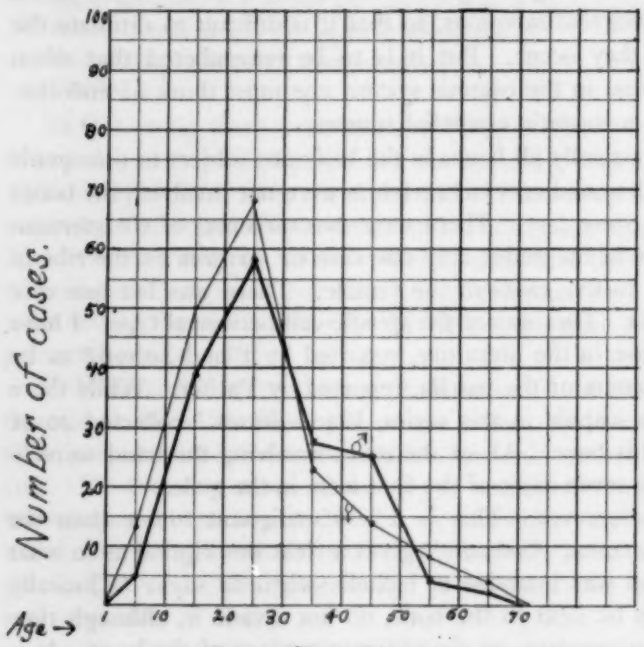

FIG. 2.—Giant cell tumors.
——— Females, 180; ——·——·—— males, 161.

There are 362 cases in the group of giant-cell tumors. Of these 192 (53 per cent.) occurred in the female, and 170 (47 per cent.) in the male. The exact age was known in 341 cases and was as follows:

Years	Male	Female
1–10	5	13
11–20	39	50
21–30	58	68
31–40	28	23
41–50	25	14
51–60	4	8
61–70	2	4
	161	180

Histogram, Fig. 2, illustrates that here the greatest age incidence is in the third decade of life with a slightly higher incidence in the female; whereas in the osteogenic sarcomas the greatest number of cases occur in the second

decade. In the male 36.9 per cent. occurred after the thirtieth year, and in the female 30 per cent. occurred after the thirtieth year. The paired bones have been quoted collectively except where the difference seemed to warrant separate mention. The distribution of giant-cell tumors was as follows:

Skull, 2.
Maxilla, superior, 20.
Mandible, 21.
Vertebræ, cervical, 2; dorsal, 11; lumbar, 10; sacral, 4.
Ribs, 7.
Clavicle, 2.
Scapula, 6.
Humerus, proximal end, 22; shaft, 5; distal end, 2.
Radius, proximal end, 1; distal end, 30.
Ulna, proximal end, 4; distal end, 13.
Hand, 9.
Pelvis, 8.
Femur, male, proximal end, 3; shaft, 1; distal end, 53.
Femur, female, proximal end, 8; shaft, 1; distal end, 34.
Tibia, male, proximal end, 16; shaft, 1; distal end, 5.
Tibia, female, proximal end, 37; shaft, 1; distal end, 4.
Fibula, proximal end, 12; distal end, 3.
Foot, 4 (all in females).

Of these 362 tumors, 86 (23.7 per cent.) involved the bones of the upper extremities; 93 (25.7 per cent.) were in the bones of the head and trunk, including the scapula and clavicle, and the remaining 183 (50.6 per cent.) were in the bones of the lower extremities. The distribution of the osteogenic sarcomas was, in the upper extremities, 16 per cent.; head and trunk, 19 per cent.; and lower extremities, 65 per cent. There is then a higher percentage of giant-cell tumors in the upper extremities and the head and trunk. The bones in which the marked difference lies are the superior maxilla, mandible, radius, ulna, and the vertebral column. In the lower extremities there is a much greater variation in distribution than in the osteogenic sarcomas. In the male 60 per cent. of all giant-cell tumors of the lower extremities occurred in the distal end of the femur, as against 36 per cent. in the female. But the proximal end of the tibia gives a percentage of 18 per cent. in the male as against 39 per cent. in the female.

In the male there was no involvement of sternum, patellæ and feet, and in the female none were found in sternum, skull, clavicles and patellæ.

Bloodgood [12] reports a series of 47 cases in which he found 13 (27.6 per cent.) in the distal end of the radius. In my collection the distal end of the radius was involved in only 11.6 per cent. of the cases involving long bones.

Dean Lewis [14] reports 17 cases of giant-cell tumors involving the vertebræ. In his cases the location was: cervical, 1; dorsal, 6; lumbar, 7; sacral, 1; not stated, 3.

Meyerding [15] reports a series of 24 cases of giant-cell tumors of the long bones. In his series the sexes were equally affected. There were eight cases in the distal end of the femur to seven cases in the proximal end of the tibia, a somewhat smaller difference than is found in this series which is 87 to 53.

Such variations may well be expected where only a small number of cases are computed.

Coley [16] in a report of 50 cases of giant-cell tumors found 27 (54 per cent.) in female and 23 (46 per cent.) in male, as compared to 53 per cent. and 47 per cent. in this series. In his group 34 per cent. occurred in the third decade of life, as compared to 37 per cent. found in this series.

Gross [7] observed that giant-cell tumors were more common in the epiphyses at the knee than elsewhere. In his series of 70 cases, 21 were in the proximal end of the tibia, and 17 were in the distal end of the femur. He reported 9 cases in the fibula, 7 in the proximal and 2 in the distal end. In my collection there were but 15 cases involving the fibula, 12 in the proximal and 3 in the distal end. He found 4 cases in which the shaft was involved; namely, femur 2, humerus 1, radius 1. Bloodgood [17] states that he has only seen 4 giant-cell tumors involving the shaft in a series of 200 cases. In my collection there were 9 cases involving the shaft, humerus five, femur and tibia, each two.

Gross found that out of 63 cases there were 33 males and 30 females. The age incidence in his series varied from 14 to 68 with the greatest number, 26, between the age of 20 and 30 years.

Bloodgood [18] gives the highest age incidence from 20 to 35; in his cases the age varied from 2 to 70 years. In this collection the youngest was a little less than 3 years and the oldest 70 years old.

Some of the older, and even some of the present-day writers, speak of giant-cell tumors as being rare in adults, and they frequently speak of them as occurring in youth. It is seen, however, that only 31 per cent. of giant-cell tumors occur before the twenty-first year, and that 32 per cent. occur after the thirtieth year; whereas 37 per cent. occur during the third decade of life.

As to the involvement of the epiphyses in giant-cell tumors of the ends of long bones, I examined 88 cases and found that the epiphyses were involved in 82 and not involved in 6 cases. This differs somewhat from the osteogenic sarcomas of the ends of the long bones where the epiphyses were involved in only two-thirds of the cases.

It is common to find a giant-cell tumor involve one of the condyles of the femur, or one of the tuberosities of the tibia extending from the joint cartilage to a considerable distance into the diaphyseal end of the shaft. The epiphyseal line seems to offer little or no resistance to the progress of this type of tumor. In the whole series of 362 cases there were only nine cases, about 2.5 per cent., of multiple tumors.

IV. *Myeloma* (Multiple Myeloma).—There are 28 cases in this series. The age was known in 23 cases, 13 males and 10 females. (See table, p. 1083.)

There was less difference in sex than reported by Ewing,[1] who found 19 in males to 7 in females. Martine, quoted by Berkheiser,[19] collected 204 cases of multiple myelomas of which 76 per cent. were in males. Berkheiser reported 2 cases in children, 3½ and 12 years old. Martine's youngest case was 24. In Ewing's cases the age ranged from 24 to 69. Eleven of the cases in my collection (39 per cent.) occurred before the twenty-first year.

Years	Male	Female
1–10	..	4
11–20	5	2
21–30	..	1
31–40	1	1
41–50	3	..
51–60	1	2
61–70	1	..
71–80	2	..
	13	10

4 adults, no exact age; 1 child, no exact age.

While many cases begin as multiple and nearly always terminate with multiple lesions of the bones, I will only cite the bones in which the lesion was first noticed and for which relief was sought.

Vertebra, 8; lower dorsal and lumbar, 4; general, with many other bones involved, 4.

Femur, 7; proximal end, 2; shaft, 1; distal ends, 2; both femurs with numerous other lesions, 2.

Tibia, 4; proximal ends and multiple, 2; distal ends and multiple, 2.

Sternum, 2.

Skull, 2; frontal bone, 1; with general multiple lesions, 1.

Maxilla, superior, 2; left orbit, 1; right side, 1.

Fibula, 1; proximal end, also in right femur, pelvis, and metatarsal bones.

Pelvis, 1; mainly in os pubis.

Humerus, 1; at proximal end.

Martine found the favorite sites to be vertebræ, sternum, ribs, clavicle, skull, scapula, ilium, and rarely in the long bones. Kaufmann [20] found them more common in the following order: vertebræ, sternum, ribs, femur, and skull.

It is surprising how general the distribution of multiple myeloma may become in a short time, so that practically all the bones, particularly the flat bones, but also the cancellous portion, and even the shaft of the long bones, become riddled with them.

Bloodgood [21] reports a case of single myeloma in the distal end of the femur in which amputation was the only treatment, and the patient was well eleven years later.

V. *Ewing's Tumor* (Endothelial Myeloma).—Eighty-seven tumors were given this diagnosis. There were 59 cases in the male (68 per cent.) and 28 (32 per cent.) in the females.

The age incidence in decades was:

Years	Male	Female
1–10	18	5
11–20	15	9
21–30	14	6
31–40	4	2
41–50	3	1
51–60	1	1
61–70	1	1
	56	25

Age not given in 3 males and 3 females.

Except for the skull, femurs, and bones of the feet, these tumors are fairly evenly distributed as to sex and paired bones; consequently, the following description as to location serves for both sexes, and right or left side:

Skull, 3; all in male.
Maxilla, superior, 1.
Mandible, 2.
Vertebræ, dorsal region, 1; lumbar, 2; sacral, 1.
Ribs, 4.
Clavicle, 3.
Scapula, 4.
Humerus, proximal end, 5; shaft, 3; distal end, 2.
Radius, proximal end, 1; shaft, 1; distal end, 1.
Ulna, shaft, 3.
Pelvis, 10.
Femur, proximal end, 4; shaft, 11; distal end, 1. There were eight in each sex, and three of those in the proximal end were of the left femur in females.
Tibia, proximal end, 8; shaft, 3.
Fibula, proximal end, 2; shaft, 4; distal end, 1.
Foot, 6; all of these were in males, 4 involved the os calcis and 2 the third metatarsal bone.

Of twenty-five tumors involving the ends of long bones, the epiphyses were involved in 8, free in 11, and not stated or ascertainable in 6 instances. Most of these cases were in children, youths, and young adults. Ewing [22] had five cases in their fourteenth year. In this series the greatest number in individual years were: 5 in the sixth, 8 in the eighth, 6 in the thirteenth, and 5 in the fourteenth year.

Ewing [22, 1] groups endotheliomas of the bone into three classes: namely, (1) solitary angio-endothelioma, more common in elderly subjects; (2) Multiple endothelioma of bone. There are fewer cases in this class, but it is found in all ages. (3) Solitary diffuse endothelioma. This is a rather common tumor in the young and most of the cases in this series belong in this class.

More of this class of tumors involve the shaft of the long bones and flat bones than is the case with osteogenic sarcomas and giant-cell tumors.

VI. *Angioma.*—1. Benign: Eight cases were reported with this diagnosis. Three were in the males, four in females; in one case, adult, the sex was not ascertained. In the males the age and location was as follows: one, 31, fourth and fifth dorsal vertebræ; one, 35, scaphoid right foot; one, 58, proximal end of right humerus. In one, adult, body of a dorsal vertebra was involved. In the females: one, adult, distal end of femur; one, 26, distal end of femur; one, 38, with right ilium and sacro-iliac region involved; one, 55, left parietal bone. Gross found that angiomas of bone, "bone aneurism," rarely occurred before the thirtieth year, whereas angio-sarcomas usually developed before the thirtieth year.

Although this group comprises less than one per cent. of this series, it is, nevertheless, an important group. Benign angiomas of bone are commonly mistaken for a more malignant tumor—telangiectatic osteogenic sarcoma,

endothelioma, of the angio-endothelioma type, which involves the same localities, such as the distal end of the long bones; also the vertebræ and the pelvis.

Delafield and Prudden [23] found these tumors were rather common in bones, especially in the proximal end of the tibia. In this small collection, however, there were no cases involving the tibia.

2. Malignant (Angio-sarcoma).—None were so diagnosed. These are now commonly diagnosed as telangiectatic osteogenic sarcomas.

VII. *Metastatic Tumors.*—There were 33 cases. Of these 30 were of epithelial origin. The age incidence of these was:

Years	Male	Female
21–30	1	..
31–40	2	3
41–50	..	8
51–60	4	6
61–70	2	..
71–80	1	..
	10	17

3 females, age not stated.

There were then two-thirds in females to one-third in males. The source and metastasis in the females were:

Breasts, 13; of these 4 showed single metastasis to femurs; 1, to femur and clavicle; 1, to 9-10-11th ribs, and proximal ends of both femurs; 1, to lumbar vertebræ; 1, to dorsal vertebræ and proximal end of right femur; 1, to lumbar vertebra and ilia; 3, gave metastasis to ribs, and 1, to right humerus. In 1 case there was general osseous carcinosis.

Thyroid, 5; 1, with metastasis to skull; 1, to right humerus; 1, to lumbar vertebra; 1, to ribs, and one proximal end of femur.

Lungs, 1; with metastasis to ribs and vertebræ.

Ovaries, 1; with metastasis to ilia.

In the male the source and destination were:

Prostate, 2; 1, to vertebra; 1, to proximal end of left humerus.

Lungs, 2; 1, to clavicle; 1, to femur, distal end.

Thyroid, 1, to proximal end of femur.

Bladder, 1, to iliac alæ, proximal ends of both femurs, and distal ends of tibiæ.

Stomach, 1, to seventh rib.

Kidneys, 1, to ribs and left humerus.

Unknown origin, 2; 1, to proximal end of tibia, the other to distal end of right humerus. In the latter case there was a pathological fracture with non-union. An exploratory operation revealed a malignant tumor and the arm was amputated.

The three other metastatic tumors were:

Chordoma, 1, in a male, 25, involving sacrum and lumbar vertebræ.

Embryonal, 2; 1, of ovarian origin in a child 2 years old, involving left

ilium; the other, origin unknown, in a girl, age 7, involving bones of right foot and twelfth rib.

The cases involving the long bones were central in most instances.

Much has been written and numerous reports have been made upon metastatic carcinomas involving the bones. The metastatic lesions in the bones are not infrequently primary as far as the patient and the physician consulted are concerned. The question of diagnosis is not always an easy one, and there are cases reported where a most careful search has failed to reveal the location of the primary tumor.

The commonest sources are: mammary, prostate, thyroid, gastro-intestinal tract, and other organs subject to carcinoma.

Dr. Percy Brown [24] gives the order of frequency in which the bones are involved from breast carcinoma as follows: 1, ribs; 2, dorsal spine; 3, lumbar spine; 4, ilia and sacrum; 5, femuri; 6, skull; 7, humeri.

Bloodgood [25] has found that metastasis is most common from mammary cancer, and gives the prostate and thyroid second and third place, respectively. He quotes Risley [26] as stating "the liability of a bone to cancerous invasion increases with its proximity to the primary site of the primary focus. Thus the sternum and ribs are affected about equally and more frequently than any other bones. The spine, femur, humerus, pelvic and cranial bones come next."

Levin [27] reports 11 cases of metastatic carcinoma in the bones. Seven from breasts, two from thyroid, and two from primary carcinoma of lungs.

Kaufmann [29] probably gives us the most valuable information, based upon more than seven hundred cases. His report is as follows:

Carcinoma of stomach, 309 cases, bone metastasis found in 2.5 per cent.
Carcinoma of uterus, 159 cases, bone metastasis found in 3.03 per cent.
Carcinoma of œsophagus, 101 cases, bone metastasis found in 6.9 per cent.
Carcinoma of rectum, 57 cases, bone metastasis found in 10.5 per cent.
Carcinoma of thyroid, 29 cases, bone metastasis found in 34.5 per cent.
Carcinoma of breast, 63 cases, bone metastasis found in 52.3 per cent.
Carcinoma of prostate, 24 cases, bone metastasis found in 66.6 per cent.

Kaufmann gives the order of frequency in which the bones were involved as follows: vertebræ, femur, pelvis, ribs, sternum, humerus—proximal end—flat bones of skull, tibia, and fibula, radius and ulna.

Stengel and Fox [28] have observed that thyroid carcinoma usually gives a single metastasis.

GENERAL DISCUSSION

One point, at least, has been emphasized by this study of location of tumors in bones; namely, that osteogenic tumors, benign and malignant, also giant-cell tumors, have sites of predilection, just as do epithelial tumors; and that just as epithelial tumors may appear in any epithelial tissue, so likewise may osteogenic and giant-cell tumors involve practically any bone in the body. The sites of predilection are: distal end of femur, 222; proximal end of tibia, 133; proximal end of humerus, 60, and distal end of radius, 35 cases.

The question naturally arises: are there any predisposing causes in these

localities which invite neoplastic changes. There is, at least, one feature which seems to be worthy of attention, and that is *growth momentum*.

There are three sources of growth of the long bones. (1) The length of the bone, which is formed at the diaphyseal side of the epiphyses; (2) the width of the bone which is formed largely by the perichondrium and the periosteum; and (3) when, at the completion of 1 and 2, the epiphysis ossifies from its endochondral centre and unites with the diaphysis. In every long bone there is an epiphyseal disc of "maximal growth," a disc at which a major part of the length of the diaphysis is produced, Keith.[4]

The amount of diaphyseal growth in proximal and distal direction has been determined by Digby.[29] His findings were as follows (percentage based upon the length of the diaphysis):

Femur, from proximal end, 31 per cent.; distal end, 69 per cent.
Tibia, from proximal end, 57 per cent.; distal end, 43 per cent.
Humerus, from proximal end, 81 per cent.; distal end, 19 per cent.
Radius, from proximal end, 25 per cent.; distal end, 75 per cent.

It is interesting to note that the sites of predilection of osteogenic tumors are in that part of those bones where there is maximal growth.

Another fact which is noteworthy is that the length of time that elapses between the appearance of the epiphyseal centre until it becomes ossified and unites with the diaphysis, is greatest in the ends of the bones which are the sites of predilection of osteogenic tumors. The epiphyseal centres for the femur and tibia at the knee, and sometimes that for the head of the humerus, appear during the ninth month of intra-uterine life; yet they are the last to unite with the diaphysis. In the femur the time between the appearance and fusion of the epiphysis in question is 21, in the tibia 21–25, in the humerus 19, and in the radius 18 years. At the other epiphyses in these bones there is not only much less growth, but also a much shorter period of growth. In other bones where osteogenic tumors occur infrequently, there is a considerably shorter period of growth.

There is, then, a considerable difference in growth momentum, tissue tension, in the various parts of bones, and the difference seems to be greatest in long bones. Senn [30] pointed out that growth momentum is a factor in bone tumors when he said: "The active physiological changes which take place during the development of the skeleton constitutes a potent exciting cause." Ewing [1] calls attention to local predispositions to tumor growth and that active growth is usually associated with active function.

Keith [5] finds that growth disorders are rare in bone which is laid down entirely in cartilage. That observation, apparently, applies equally well to tumors of the bone, as no tumors were found at the base of the skull, and tumors of bone developed entirely in cartilage, as the carpus and tarsus, are comparatively rare. Keith believes that in cases of growth disorders of bones there is probably some underlying endocrine disturbance.

Conclusive evidence that endocrine functional disturbance is a factor in bone growth is seen in cretinism where the bones fail to develop at the

epiphyses with the result that there is stunted growth and in severe cases ossification fails to take place. Nevertheless, the periosteal bone formation continues in these cases so that the thickness of the bones in cretins is as great, or even greater, as in a normally developed individual, Macleod.[31] It is conceivable that some form of endocrine disturbance may be a factor in the loss of growth restraint.

Inasmuch as a considerable number of tumors were found in children, the following tabulation of tumors for the individual years in the first fifteen years of life seems to be warranted:

TABLE I

Age	Osteogenic				Giant cell tumors		Multiple myeloma		Endothelial myeloma		Metastatic embryonal		Total
	Benign		Malignant										
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1				1									
2											1		
3			2			1		2		1			
4	1			2				1	1				
5			2	2		1							
6			3	1		3			5				
7			1			3		1	1	1	1		
8			1	2		1			8	1			
9			2	3	3	2			2	1			
10			3	4	2	2				1			
11	1		3	4	2	1		2	4				
12			4	2			1		1	1			
13			12	7	3	7			5	1			
14			8	6	7	4	1		2	3			
15		1	10	5	3	1							
	2	1	51	39	20	26	2	6	29	10	2		188

There are a total of 188 cases (18.9 per cent.) before the sixteenth year. There are only 3 cases in the benign osteogenic tumor group and 2 in the metastatic group. Multiple myeloma occurred before the sixteenth year in 28.6 per cent. of cases of myelomas. Nevertheless, it is a comparatively rare tumor in childhood, only 4.2 per cent. in this series.

There are then only three classes of tumors which are common in children, namely: Osteogenic sarcomas, 90 (48.1 per cent.); giant-cell tumors, 46 (24.3

per cent.), and endothelial myelomas, 39 (20.6 per cent.). A total of 93 per cent. of all the bone neoplasms that occur before the sixteenth year.

The youngest case was that of a little girl, 18 months old, with an osteogenic sarcoma in the shaft of the left tibia. This tumor had been present eight months when consultation was sought, so that the child was only 10 months old when the tumor developed. This was an encapsulated tumor, central in origin. It was removed with a curette, followed by chemical cauterization. The child was well three years later. (See Case 453, Codman Registry of Bone Tumors.)

On comparing the prevalent age at which osteogenic tumors occur and that at which sarcoma in general occurs, McCosh's[34] observations are of interest. He found the prevalent age for general sarcomas to be in the fourth decade of life, whereas in the osteogenic sarcomas it is in the second decade, twenty years earlier.

Whether or not these conditions are factors in the formation of bone tumors is problematical. The fact remains, nevertheless, that *the sites of predilection for osteogenic and giant-cell tumors are at the end of long bones where there is a disc of "maximal growth," where the growth period is longest, and the natural growth momentum is greatest.*

Table II conveys at a glance what tumors one may expect to encounter in a given locality of the skeleton, as well as the frequency with which they occur, based upon the analysis of 1000 cases. So, for instance, the analysis reveals that the only single tumors which occurred in the bones of the hand were osteogenic or giant-cell tumors. The sternum is rarely the seat of a single tumor, only one benign and two malignant cases were encountered, although it is commonly involved in cases of multiple tumor of the osteolytic type.

The patella seems singularly immune to bone tumors, in spite of the fact that it is probably subjected to a far greater amount of trauma than any other bone in the body. It seems reasonable to assume that the immunity to bone tumors which the patella enjoys is probably due to the absence of loss of growth restraint, incident to active diaphyseal growth and pressure epiphyses. The fact that the patella develops from an endochondral centre, that it has a relatively short period of growth, and that it is a sesamoid bone, may be of importance. (Since the above material was gathered, I have found another case of osteogenic sarcoma of the patella. In these two cases there was a history of direct trauma. Both cases were fatal.)

Then, too, it is to be observed that the localities in which most malignant tumors occur are also the seat of the more benign tumors. Given a tumor in the proximal end of the humerus, for instance, it is erroneous to assume that it is malignant; inasmuch as there are about two giant-cell tumors to three osteogenic sarcomas in this region. In the lower end of the femur about the same ratio of giant-cell tumors and osteogenic sarcomas is seen.

A perusal of this condensed analysis ought to stimulate one to leave no stones unturned in an effort to reach a definite diagnosis before instituting

radical treatment for a bone tumor; inasmuch as an erroneous diagnosis and unnecessary radical treatment is of far greater importance to the economic and social welfare of the patient than is an unnecessary so-called major operation for the removal of some minor anatomical organ of little or no physiological importance.

I would not for one moment have the reader entertain the idea that this

TABLE II.

Comparative Location of 1000 Bone Tumors

	Osteogenic Tumors						Giant Cell Tumors			Myeloma (Multiple)			Endothelial Myeloma			Metastatic Tumors	Periosteal Fibrosa.	Angioma, benign
	Benign			Malignant														
Skull	1			8			2			2			3			1		1
Maxilla, sup.	1			10			20			2			1					
Mandible	2			5			21						2					
Vertebrae	1			8			27			8			4			5		2
Ribs	1			6			7						4			7		
Sternum	1			2						2								
Clavicle				9			2						3			1		
Scapula	1			14			6						4				2	
Humerus	P. 2			P. 31	S. 13	D. 10	P. 22	S. 5	D. 2	P. 1			P. 5	S. 3	D. 2	5	D. 2	P. 1
Radius				P. 2	S. 2	D. 4	P. 1	-	D. 30				P. 1	S. 1	D. 1		S. 1	
Ulna			D. 1	P. 3	S. 1	D. 3	P. 4	-	D. 13				-	S. 3	-			
Hand	3			3			9											
Pelvis	1			20			8			1			10			4		1
Femur	P. 3	S. 1	D. 8	P. 15	S. 20	D. 139	P. 11	S. 2	D. 87	P. 2	S. 3	D. 2	P. 4	S. 11	D. 1	8	D. 1	D. 2
Tibia	P. 5			P. 69	S. 6	D. 8	P. 53	S. 2	D. 9	P. 2	-	D. 2	P. 8	S. 3		1		
Fibula	P. 2			P. 13	S. 4	D. 4	P. 12	S. -	D. 3	P. 1			P. 2	S. 4	D. 1			1
Foot	1			8			4						6			1		
Patella				1														

P.—Proximal end; S.—Shaft; D.—Distal end. Where there were multiple tumors, the single tumor indicated is that which caused the first symptoms.

is offered as a complete analysis of bone tumors. Class VIII, inflammatory conditions that may simulate tumors, is so important that the cases under this classification far outnumber all the others. Osteitis fibrosa cystica is considered identical with giant-cell tumor, by some competent observers; whereas others believe it to be a distinct entity. Be that as it may, it rarely offers the same difficulty in diagnosis which is encountered in differentiating between malignant and benign non-cystic bone tumors.

Tumors of dental origin need to be considered in diagnosing a new growth of the maxillary bones.

The osteolytic tumors, myelomas, originate in the bone-marrow, usually in the flat bones and cancellous portion of the long bones. There is, however, no limitation to their ultimate distribution.

Metastatic tumors seem to have no definite predilection as to bones. They commonly seek out the areas of red bone-marrow, the flat bones and the cancellous portion of the long bones. The ends of the long bones nearest the trunk usually suffer first, although the metastasis which gives the first symptoms may be in distal bones.

SUMMARY

1. Of osteogenic sarcoma, 58.7 per cent. occur in the male, and 41.3 per cent. occur in the female.

2. The highest age incidence for osteogenic sarcoma, for both sexes, is in the second decade of life, although more than 33 per cent. occur after the thirtieth year.

3. The epiphyses are not involved in at least 33 per cent. of osteogenic sarcomas at the diaphyseal ends of long bones.

4. The epiphyses are invaded in 90 per cent. of the giant-cell tumors involving the ends of long bones.

5. Both sexes are about equally affected with giant-cell tumors, namely female 53 per cent., male 47 per cent.

6. Giant-cell tumors are most common in the third decade of life, but 32 per cent. occur after the thirtieth year.

7. Myeloma (multiple myeloma) is not a disease limited to adult life, 39 per cent. occur before the twenty-first year.

8. Benign angiomas must be considered in every diagnosis of a vascular tumor of the bone.

9. Solitary diffuse endothelioma is not an uncommon tumor, especially in younger people.

10. Predisposing sites for osteogenic tumors, benign and malignant, and giant-cell tumors, are at the ends of long bones, where there is an epiphyseal disc of maximal growth, where the growth period is longest, and where the natural growth momentum is greatest.

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PLEXIFORM NEUROMA

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The interpretation and classification of tumors of the nervous system, and particularly of the peripheral nerves, have been the subject of much investigation and many changes during recent years. In spite of this, there are many doubtful points and much disagreement in regard to the origin and growth of these neoplasms. This is not surprising, inasmuch as the origin of some of the normal structural elements of nerves, such as the cells of the sheath of Schwann, is still undetermined; in fact, the true method of the formation and growth of nerve fibrils has not yet been conclusively proven.

It is agreed that the entire central nervous system is derived from the thickened walls of a dorsally situated axial plate, which subsequently becomes converted into a canal and runs forward in front of the primitive streak. The walls of this canal are composed of ectoderm, so that it follows that the whole structure of the central nervous system is laid down in that layer. This is probably true for all of the nerves of the body. The layer of columnar epithelium which at first composes the neural plate, undergoes a series of complex, developmental changes, resulting in the partial disappearance of cell outlines and the formation of a protoplasmic network or syncytium with thickly interspersed nuclei distributed throughout its entire extent. These nuclei become grouped, so that three layers or zones may be distinguished. In the innermost zone the primitive cells divide by mitosis to form indifferent cells. From these by a further transformation in which the nuclear proliferation is very active, there appear two types of cells: the future nerve cells or neuroblasts, and the cells of the framework or the spongioblasts. According to Bryce [1] it is generally admitted that these two types of cells spring from multiplying ectodermal cells and that consequently the neuroglia elements are also of ectodermal origin, although mesodermic elements are carried in with the invading blood-vessels. Heisler [2] also expresses the same opinion. In regard to the differentiation of the neuroblasts, His,[3] whose theory has usually been accepted, stated that each neuroblast has a separate protoplasmic body from which the axis cylinder grows out in the form of a protoplasmic process which, by further extension, becomes the nerve fibre. Held [4] advocated that the neuroblasts are cells of the syncytium and not free processes traversing its meshes. Both agree, however, that the nerve fibre is an active growth from the neuroblast. The idea that the conducting fibrillæ are laid down *in situ* along a protoplasmic path provided by the syncytium, of which the neuroblasts are cellular elements, is championed by Apathy.[5]

The developing nerve paths are sprinkled with nuclei, which are generally thought to represent the nuclei of the sheath of Schwann, the origin of

which is variously interpreted. According to Schultze [6] and Hertwigs,[7] the nuclei of the sheath come from the cells which enter into the formation of the nerve fibres, while others—Held,[4] Baer,[8] His,[3] Cajal,[9] Kolliker,[10] and Balfour,[11] attribute them to a secondary investment either of mesenchyme or of ectodermal cells derived from the neural crest or from the neural tube along the motor root. There may be some confirmatory evidence of this in the experiments of Harrison,[12] who has shown that removal of the neural crest prevents development of the peripheral nerves. In frog embryos he observed the growing fibres with their branching and change of form. Bryce [1] says that "This derivation of sheath cells from the neural crest ectoderm has suggested that the peripheral extension of the nerves may be associated with a continuous proliferation of indifferent cells which may become ganglion cells in the sympathetic, or sheath cells in the nerve trunks." Arey [13] contends that the sheath cells are derived from the supporting cells of spinal ganglia, enveloping the axon processes of both dorsal and central root fibres and are continuous with the capsule of the ganglion. He says in addition that it is certain that many of the sheath cells migrate peripherally along with the developing nerve fibres. Nemiloff [14] concluded that the nuclei of the sheath of Schwann are added to the axis cylinder from the surrounding cells during the development of the nerve fibre and that they are not parts of the neuron proper or of the neurilemma, but rather of the spongio-protoplasmic network which spreads throughout the myelin sheath.

That the histogenesis of nerve tissue and the mode of formation and growth of nerve fibres is exceedingly complex is witnessed by the number of hypotheses which have been advanced in explanation. Bryce,[1] in the section on Embryology in Quain's Anatomy, mentions no less than six, and states that "divergent results of different observers in matters of detail cannot yet be brought into line with any general hypothesis." The general view is that nerve fibres grow out from preëxisting ganglion cells making their way to the end organs. Is it possible for nerve fibrils or axis cylinders to grow apart from ganglion cells? Ewing [15] states that it is. Verocay [16] contends that it is possible, not only for nerve fibre cells to originate from the cells of the sheath of Schwann, but that ganglion cells also might arise from these elements. In discussing the function of the sheath of Schwann, Herrick [17] mentions its protective quality and also that it plays a part in the chemical process involved in the act of nervous conduction. He further adds that the nuclei play a very important part in the regeneration of the severed nerve fibres. When a nerve fibre is cut off from its cell body, it dies, but in the case of a peripheral fibre, the nuclei of the sheath do not die, and with the aid of these nuclei a new fibre may, under favorable conditions, be formed. In an investigation on the regeneration of severed nerves, Cone [18] states that he has followed rows of the nuclei of the sheath of Schwann along until there was seen a transition to young, varicose, nerve fibrils, and he suggests that it is very likely that the nuclei are directly transformed into nerve fibrils. He quotes Von Bungner as saying that these nuclei are certainly of nerve

nature and must be called neuroblasts. Cone [18] further quotes Baer's statement that the sheath cells die in anterior poliomyelitis, which partly explains why the nerves do not regenerate in this condition, and he feels that this has some bearing on the contention that nerve fibres regenerate from these cells. It is difficult to see the value of this observation, however, as the ganglion cells also are involved in anterior poliomyelitis.

In view of the fact that the origin of certain elements of the nervous system and the method of nerve fibre growth is still a matter of controversy, one can readily understand the great interest and difficulty attendant upon the study of certain tumors of the nervous system, and particularly those of the peripheral nerves in which the structure is apparently a neoplastic growth of nerve fibres. As the so-called plexiform neuroma seems to be structurally such a tumor, the report of an unusual example of it would appear to be worth while.

MacCallum [19] states that the "type of tumor finally evolved from nerve elements seems to depend upon the stage in embryonic development at which the formative cells were diverted to the formation of a tumor." And he further contends that there is probably no such tumor as one composed solely of tangles of nerve fibres, a conclusion with which Spiller [20] agrees. Bruce [21] says that true neuromata are very rare. Senn,[22] in his text-book on pathology and treatment of tumors, mentions a case described by Czerny in which the tumor was composed of new non-medullated nerve fibres. Froboese [23] states that some of the cases reported were due to technical errors in specimen preparation and he describes a true plexiform neuroma of proliferating medullated nerve fibres without ganglion cells. The axis cylinders could be clearly recognized and the tumor was due almost entirely to specific nerve tissue, and he concluded that the occurrence of true neuroma not containing ganglion cells is possible, and that the existence of a true neuroma cannot be excluded because of its plexiform nature.

Verocay,[16] whose work has been the subject of much comment, in discussing the nature of the multiple tumors of the nervous system in a patient whom he studied, concluded that the peripheral tumors originated from the cells of the sheath of Schwann. These cells, he says, increased diffusely over the whole length of a nerve or at circumscribed places, and thereby evidently produced the tumors by their increase and differentiation. He concluded that the peripheral tumors and the tumors of the spinal cord in his case were not due to a coincidence of two different pathologic processes, but were intimately related histogenetically. A point of major importance in the consideration of isolated tumors of this nature, in that there is always the possibility of other areas of latent, neoplastic growth in the nervous system which have not had the time or stimulus to manifest themselves clinically. He thinks that the tumors are due to a disturbance in the development of the specific elements of the nervous system and believes that these changes occur in early embryonic life when the indifferent cells are still able to form ganglia, glia or nerve fibre cells. Landau [24] also expresses this opinion and holds that

the principal period of cell and tissue differentiation for the whole neuro-ectoderm is found during embryonic life. This process is intense and the greatest possibility of encountering cellular alterations that constitute an anlage for tumor formation occurs at this time. He considers these tumors from a histogenetic point of view and concludes that they arise from the cells of Schwann's sheath which are found throughout the body. Herxheimer and Roth,[25] in a study of Recklinghausen's disease, agree with Verocay's conception, and think that the indifferent elements are affected by disease during intra-uterine life, when the development of various portions is at different stages. Adolf Wallner [26] considers these tumors as being due to a congenital anlage and regards them as a malformation in the broadest sense of the word. Kirch [27] described nerve fibre tumors as starting from the cells of the sheath of Schwann and attributes them to disturbances in the development of the ectodermal medullary tube.

In a recent paper Erb [28] collected forty-seven cases of nerve fibre tumors from the literature and contends that the matrix of the tissue is represented by embryonic, preliminary stages of Schwann's nucleus, Held's neurogliocytes, which are multipotent and also produce glia. He classifies them as a system disease or a malformation in which heredity plays a great part. Sommer [29] calls them a product of the glia and of Schwann's nucleus. He describes the tumors as usually being solitary, surrounded by a capsule and varying in size from a millet seed to that of an apple, and says that they may appear anywhere in the course of the sensory, motor, or sympathetic nerves. Cushing [30] mentions the predilection of tumors composed of this peculiar neurogenous tissue for the acoustic nerve, and several authors comment upon the relationship between isolated tumors and the structural anomalies underlying Recklinghausen's disease. Proc and Brun.[31] Erb [28] states that these tumors have a preference for the spinal cord, particularly its sensory root. They appear chiefly in youth and have a somewhat greater incidence in the male sex.

Symptoms.—When peripherally located, the growths cause paræsthesia and later pain, which is increased by pressure on the nerve. In motor or mixed nerves, varying degrees of paralysis may be noted in addition. Malignant degeneration has never been observed (Sommer [29]), but the entire nerve length is doomed to tumor formation. (Ewing.[15]) The growth is slow and progressive and in the case reported it apparently spread only distally. However, the possibility of proximal growth, with involvement of the spinal cord, must be kept in mind. Many observers have described various stigmata in association with these tumors and not a few instances of simultaneous or subsequent involvement of the cord have been remarked. Beriel and Viret [32] note that extension in the nerve roots outside the spinal foramina may simulate intraspinal extension and that peripheral tumors may precede intraspinal extension by many years. In advancing directly along a nerve, an originally extraspinal tumor gradually progresses toward the cord, entering the foramen, where it becomes strangulated. It then extends slowly within

the spine, producing compression and secondary lesions of the cord, especially a state similar to syringomyelia. Occasionally the size of the tumor is great enough to be an incumbrance, and to cause a sense of great weight and dragging.

Treatment.—The tumor should be removed as soon as it is noticed. When it has progressed to a stage where it causes pain and disability, these are only added indications. It should be enucleated, if possible, sparing the nerve. "Nerve resection is never justifiable" was a dictum of Senn [22] long ago laid down, but it is not always possible to spare the nerve. The prognosis would be good were it not for the fact that it may be necessary to sacrifice the nerve and again it must be remembered that there is often a central disturbance of development in these cases. Ewing [15] states that "these tumors are often amenable to persistent mild doses of X-ray and that although they are rarely malignant, still the entire nerve is doomed to tumor growth." Early diagnosis is important and effective surgical removal indicated before the progress of the growth imperils the cord. Again it is important to emphasize that degenerative lesions of other parts of the nerve structure are to be remembered in the consideration of these cases. Ott [33] has recently reported his experience in the surgical treatment of solitary tumors of the peripheral nerves and he shows how benign tumors can be shelled out of the nerve by splitting the capsule in a longitudinal direction so as to preserve the nerve fibre. This should always be done, of course, where it is possible, as it is no small matter to destroy a large mixed nerve. It will sometimes be impossible, however, to remove the tumor without varying degrees of damage to the nerve itself, and if the removal of the tumor necessitates a resection of the nerve, the resulting paralysis and sensory disturbance, with the consequent deformity, must be minutely described to the patient before operation is undertaken.

Report of Case.—J. A. H., a male, age twenty-four, stenographer, was referred to me by Dr. Harold Hughart because of a tumor extending the full length of the left upper extremity. Nine years before, when the patient was fifteen years old, a few hours after an injury to the arm sustained while playing football, he first noticed a small swelling in the left axilla. He thought that "a muscle had been torn loose." The lump was very tender, but never discolored. It never bothered him from that time until one year before admission, with the exception that it gradually grew down his arm until it extended to the middle of the hypothenar eminence. It has also grown thicker and rounder in the meantime and has been growing more rapidly recently. He has never noticed any growth upward from the original lump, but now there is some tenderness just above the clavicle.

About a year ago he noticed for the first time a feeling "like the hand had gone to sleep," and it gradually became painful. The pain is dull, dragging and constant. It starts at the shoulder and darts down the arm and into the hand, where it is most severe in the fifth finger. It is sometimes felt in the other fingers, but never in the thumb. It is always worse at night and has greatly interfered with his sleep. The tumor is so large that it is constantly being struck or injured, each time causing very acute pain. In his words: "My arm feels like it weighs a ton." He has lost twelve pounds during the past year and while he is still able to continue his work, he notices that the fingers are clumsy, get stiff when tired and interfere with each other.

The family history reveals nothing of interest with the exception that one brother died at the age of twenty-nine after an unusual chronic illness. Four years before his death an abdominal operation revealed multiple, small tumors of the large and small intestines, the nature of which I am unable to learn. Soon after this he developed symptoms of a brain tumor for the relief of which he was operated upon by Doctor Adson, who kindly advises me that a bilateral, cerebellar exploration was done with a decompression for a degenerating, cystic glioma of the left cerebellar lobe. It is possible in view of this, that the small tumors of the intestinal wall were nerve fibre tumors arising from the sympathetic plexus in the intestinal wall. The familial nature of the condition under consideration has been often remarked.

FIG. 1.—Microphotograph of section showing interspersed nuclei and branching fibrils.

The physical examination reveals no abnormality other than the tumor in the left arm and forearm. When the limb, which is generally larger than its fellow, is abducted to a right angle, the tumor seems to hang from the full length of its lower border like a drapery. Abduction and elevation of the arm increases the pain and the tumor becomes taut and immovable. It is a large cable-like mass extending from the summit of the left axilla along the inner and posterior aspect of the limb to the base of the fifth finger. It is two inches in diameter in its largest part in the arm, cylindrical and movable laterally, but not in the direction of the longitudinal axis of the limb. It is tender in all its course, but no more so in one place than in another. In the arm it is divided into four globular sections by transverse grooves, as though it had been constricted by narrow bands. At the bend of the elbow there is an absence of the tumor which again appears just below the inner condyle, spreading out in the forearm to form an irregular, spindle-like mass which extends into the hypothenar eminence. It is not attached to the skin or underlying structures, but follows the course of the ulnar nerve for its entire length. Just beneath the skin, below the elbow on the inner and anterior aspect of the forearm there are several smooth, movable bodies, each about the size of a bean. They are very tender and move freely laterally, but not up and down and seem to be in the internal cutaneous branches. When moved, they cause the arm to feel numb over an area several inches in extent. There is no dilatation of the superficial vessels and no pigmentation or other involvement of the skin.

It was at once recognized that the tumor was of, and in, the ulnar nerve, and operation was advised. As there was some doubt as to the possibility of its removal

without damage to the nerve, the consequences of partial or complete ulnar paralysis were fully pictured to the patient. He expressed his desire to be quit of it under any condition. I was prompted to attempt to remove the tumor, even if it should mean a resection of the nerve for the following reasons: 1. The increasing pain and sleeplessness. 2. The possibility of preventing an extension upward into the cord. 3. The chance that the tumor might be undergoing a malignant change, owing to the recent rapid increase in growth, although this seemed improbable as it was so freely movable and strictly limited.

Operation: August 14, 1924. Ether anæsthesia. Through an incision on the inner surface of the arm the tumor, which was limited to the ulnar nerve, the fibres of which could be seen thinned and spread out in the mass, was liberated. It shelled out easily through the plane of loose cellular tissue which surrounded it from the axilla to the elbow. The upper limit of the growth was so high in the axilla that it was necessary to divide the pectoralis major muscle to reach it, after which it was removed with great difficulty, owing to the intimate relations of the other trunks of the brachial plexus to the involved ulnar nerve. With much regret that it was found impossible to spare the nerve, it was divided above the growth and the mass turned out. The incision was continued down the forearm and the lower limits of the tumor shelled out of the group of flexor muscles to which it was closely attached. The small superficial ramifications were also removed. Hæmostasis was completed, the pectoral muscle repaired and the wound closed.

Convalescence was uneventful and in a week the patient was discharged to his home.

The pathological report: For the following comprehensive report on the pathology of the tumor and microphotograph (Fig. 1) of the section, I am deeply indebted to Dr. James Ewing, who states in a personal communication that "the tumor is a typical neuroma, plexiform in type, composed mostly of nerve fibrils, very few cells; in this it is remarkable. I do not think it is malignant, but recurrences often develop from other portions of the same nerve trunk, all of which is condemned to tumor growth. The lymph-nodes are not involved."

Description of Plexiform Neuroma of Ulnar Nerve.—"The entire tumor measures 26 inches in length. (Fig. 2.) It is composed of a series of swollen segments, several of which measure 4 x 3 x 2 inches. These are connected by more constricted nodes. At the lower end two branching nerve trunks appear, which are eight and ten inches in length and are only moderately enlarged and nodular, their greatest thickness being three-quarters of an inch. The tumor masses are all well encapsulated, smooth, shiny, firm, elastic and translucent.

FIG. 2.—Gross specimen. A. Original mass in axilla. B. Constriction of nerve at internal condyle. C. Mass in forearm.

"On section the structure presents chiefly intertwining fibrils between which are comparatively few cells. These are composed of much elongated oval nuclei, which

he in or on the hyaline masses of fibrillar material. There is no other cell cytoplasm visible except this fibrillar material. No cells resembling gangion cells are seen. There are very few blood-vessels. The elongated masses of hyaline material invariably break up into fine fibrils, which compose the bulk of the tumor mass. It is difficult to determine the exact nature of these cells and fibrils. They do not have the appearance of fibroblasts and collagen fibrils, but much more resemble glia fibrils. According to Verocay [16] the fibrils of neurinoma are glia fibrils derived from the cells of the sheath of Schwann, which are modified nervous elements and not connective-tissue cells or endothelium. The structure of this tumor supports Verocay's interpretation, and indicates that the growth arises mainly from the cells of the sheath of Schwann, and that these cells are essentially glia cells, and that the tumor is composed mainly of glia fibrils. It is possible also that the fibrillar material represents axis-cylinder structures, in which the fibrillar character is exaggerated, and the bulk of fibrils greatly in excess of that from any other element in the nerve trunk. The presence of long nuclei imbedded in the fibrillar material is against this hypothesis, since there are not normally any ganglion cells in the nerve trunk which could give rise to such nuclei and axis cylinders. Nevertheless, a new growth of axis cylinder material and fibrils apart from growth of ganglion cells is possible."

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FINAL RESULTS OF THE OPERATIVE TREATMENT OF GASTRIC ULCER*

A STUDY OF TWENTY-TWO CASES SUBJECTED TO THE POLYA OPERATION OF PYLORIC RESECTION WITH GASTRO-ENTEROSTOMY

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Such rapid strides have been made in recent years in the treatment, both medical and surgical, of chronic gastric ulcer that it is sometimes difficult to decide which form of management to employ in a given case of ulcer unless there is a clear-cut indication for either conservative treatment or for surgery. The indications for either form of treatment are, however, not clear cut if we except those complications such as perforation, organic stenosis, uncontrollable hemorrhage or suspected malignant degeneration. Considerable difficulty may be experienced in deciding when an uncomplicated, chronic gastric ulcer has passed out of the realm of the internist and when operation becomes the logical procedure. It is not our intention, however, to discuss the pros and cons for either prolonged medical treatment or for surgery, but simply to describe a series of cases of chronic gastric ulcer in which we believe operation was indicated and to report the results at varying periods after the operation as determined by examination of the patient physically, by X-ray, examination of the gastric contents and the post-operative course relative to the working capacity of the patient, the condition of his bowels, his food and his general health.

The type of gastric ulcer selected for operation is that which had failed to respond permanently to further medical management, after being present clinically for a period varying from six months to eighteen years, and one in which the X-ray evidence pointed to an ulcer of considerable size and chronicity Another point taken into consideration was the economic status of the patient. Nearly all of our operative patients were working men who were dependent solely on their own earning capacity for the support of their families and themselves and could not afford to live on a special diet for a long time or spend a certain number of weeks in bed at varying periods when their symptoms recurred.

The choice of the method of operation is, in our opinion, as important as the selection of the proper kind of cases. The ideal operation should fulfill at least four conditions. It should remove the lesion, it should eradicate the conditions which are commonly supposed to be important factors in the production or recurrence of gastric ulcer, it should be practical and leave no

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bad after effects and it should restore the patient to a comfortable state of health so that he may go about his business. The element of risk should, of course, be as small as possible, and is an important condition to be considered in any form of treatment.

We have chosen the method of pyloric resection with gastro-enterostomy (Polya) as a type of operation which best fulfills the above-named conditions. The ulcer itself is thus removed and the possibility of recurrence greatly

TABLE I.

Comparison of the Gastric Contents Before and After Operation as Determined by an Ewald Test Meal.

Case No.	Before operation		After operation	
	Free HCl	Total acidity	Free HCl	Total acidity
1	45	70	0	18
2	37	57	0	24
3	34	62	0	6
4	30	75	0	28
5	18	48	0	8
6	46	68	0	12
7	46	56	0	8
8	—	—	0	10
9	46	80	0	10
10	50	70	0	23
11	0	31	0	15
12	30	49	0	15
13	40	65	0	25
14	70	110	0	5
19	41	64	0	22
20	10	20	0	10
21	56	86	0	12
22	54	88	0	15

reduced since the ulcer-bearing area of the stomach is excised. This point is well illustrated by the fact that 75 per cent. of gastric ulcers occur in the pyloric region of the stomach and a removal of this portion is undoubtedly an important factor in preventing a recurrence. In addition to removal of the ulcer-bearing area, pyloric resection reduces the secretion of gastric juice to a negligible quantity and thus eliminates one of the most important factors in the recurrence and chronicity of gastric ulcer. Clinical and experimental data show that resection of the pyloric portion of the stomach reduces the secretion to the vanishing point in practically every instance. R. Lewisohn [5] in a study of his cases after one to three years following pyloric resection,

reports that the acidity of the gastric contents is absent or greatly reduced as compared with the pre-operative findings. He is of the opinion that simple gastro-enterostomy is not followed by such a marked reduction in the acidity of the stomach contents. Similar results are reported by H. Lorenz and H. Schur,[6] M. Madlener [7] and H. Finsterer.[3] The effects on gastric secretion after simple gastro-enterostomy are much less striking. Schur and Plaschkes [8] found a moderate reduction in acidity and only occasionally was complete anacidity present after simple gastro-enterostomy. J. J. Conybeare,[1] in study-

TABLE II.

Showing the Emptying Time of the Contrast Meal on X-ray Examination.

Case No.	Slow	Rapid	Very rapid	Case No.	Slow	Rapid	Very rapid
1		x		12	x		
3		x		14		x	
5		x		17		x	
6			x	20			x
7	x			21		x	
9		x		22		x	
10		x		24		x	
11			x	Total	2	10	3

ing a series of 28 cases after simple gastro-enterostomy, found absence of HCl in 18 and hyperchlorhydria in 4. Experimental evidence is also present, showing the striking reduction in gastric secretion after pyloric resection. W. Gross,[4] working in Pawlow's laboratory, showed that the introduction of meat extract into an isolated pouch in the fundus of the stomach produced little or no secretion, while introduction of the same extract into the duodenum produced a marked secretion of gastric juice. This author also corroborated the work of Edkins,[2] who found that an extract of pyloric mucosa given intravenously produced a marked secretion of gastric juice, while an intravenous injection of an extract of the fundus mucosa was followed by little effect. More direct experimental evidence of the value of pyloric resection in reducing gastric secretion is furnished by the work of H. Smidt,[9] who worked with the Pawlow pouch after performing various operations on the stomach. This author found that resection of the antrum was followed by a marked reduction in gastric acidity. The psychic secretion of gastric juice was not greatly influenced by this procedure.

The results in our own cases, studied at varying periods of from one to fifteen months after operation, showed a similar striking and permanent reduction in gastric secretion. This is illustrated by Table I, which shows the results obtained in 18 cases after pyloric resection. Free HCl was absent in all instances and the total acidity was very much reduced as compared with the pre-operative findings.

A study of the emptying time after operation as determined by X-ray was made in 15 cases. Table II, giving the results of this study, shows that the

TABLE III.

Showing the Condition of the Bowels after Operation.

Case No.	Constipation	Normal	Diarrhœa
6		x	
7		x	
8		x	
9		x	
10			x
12	x		
17		x	
18	x		
19		x	
20		x	
21		x	
22		x	
Total	2	9	1

stomach empties rapidly in nearly all instances. Rapid emptying is of value in that the stomach obtains a maximum of rest, the contact of food with the gastric mucosa is as short as possible and the acid contents, if at all present, are rapidly evacuated, thus aiding in the prevention of further pathology by these factors.

The rapid emptying of the stomach may, however, be attended by certain intestinal disturbances, the most important of which is diarrhœa. A study was therefore made to determine the condition of the bowels after operation in 12 cases. It is unfortunate that more patients did not respond for reëxamination relative to the condition of their bowels. This is due chiefly to the fact that our material consists of people many of whom are transients and who disappear without leaving any trace as to their whereabouts. Table III shows that of the 12 patients who were reëxamined for the condition of their bowels, 9 had one or two normal, well-formed bowel movements daily, 2 were constipated, and only 1 had diarrhœa.

The patients were further studied as to the nature of their diet after

operation, gain in weight, working capacity and their general condition as regards symptoms of various sorts. Of 13 patients who reported relative to their diet after operation, 12 stated that they were eating ordinary food three times a day without any apparent discomfort. The remaining patient was on light food, but had been operated only one month before. Twelve patients reported their weight. The condition of their weight and length of time since their operation is illustrated by Table IV, which shows that the

TABLE IV.

Showing Length of Time Since Operation and Gain in Weight.

Case No.	Time since operation	Gain in weight
6	12 months	21 pounds
7	15 months	None
8	1 month	12 pounds
9	3 months	24 pounds
10	5 months	22 pounds
12	6 months	5 pounds
13	6 months	None
17	3 months	4 pounds
19	2 months	2 pounds
20	7 months	35 pounds
21	7 months	13 pounds
22	8 months	5 pounds

average gained was 12 pounds and only 2 patients remained the same as before operation.

Nine patients reported their working capacity and all but one had returned to their usual occupations. Eleven patients stated that they were in good health and practically without symptoms and one other reported that he considered himself very much improved. The series as a whole includes 22 cases, all of whom were operated by the Polya method with but one death after operation.

Résumé.—1. A series of 22 cases of gastric ulcer are reported in whom it was thought operation was the treatment of choice in view of the failure of permanent relief after medical management and because the clinical evidence pointed to a chronic ulcer of considerable severity and resistance to conservative treatment.

2. A study of these cases at varying periods after operation showed that there was an absence of free HCl in the stomach contents in all of the 18 cases which were reëxamined; the emptying time as determined by X-ray was rapid in 10 of 15 cases which were reëxamined; the bowels were normal in 9 out of 12 instances, and diarrhœa was present only in one case and

the patients as a whole were greatly improved after operation, as shown by freedom from symptoms, gain in weight and a return to their former occupations.

3. In the type of gastric ulcer selected for this series we believe that resection of the pyloric antrum is the treatment of choice because it removes the ulcer and the ulcer-bearing area of the stomach and eradicates those factors such as the gastric juice and the retention of stomach contents which are considered to play an important part in the formation, chronicity or recurrence of peptic ulcer.

4. No ill effects were noted after the operation and diarrhœa was present in only one of the reëxamined cases.

5. With the exception of one death and one patient who was doing only light work, all made a complete recovery without further symptoms and were back at their regular occupations.

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THE OPERATIVE TREATMENT OF ARTHRITIS DEFORMANS OF THE HIP-JOINT*

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A paper on the operative treatment of osteo-arthritis of the hip is practically limited to cases of confirmed disability in which the other joints are free from disease, at least in a disabling sense. In the etiology of this

Fig. 1.—Illustrates the mechanical predisposition to arthritis deformans. The patient, a man sixty-four years of age, had apparently in childhood coxa vara, probably of traumatic origin. This had caused no particular inconvenience until the age of sixty-two years, when characteristic symptoms of arthritis deformans appeared. The X-ray picture shows typical changes, particularly the diminution of the intra-articular space as compared with the opposite side.

so-called malum coxæ senilis, beside the lack of resistance which the name implies and local or systemic infection one must recognize as a factor of great importance, both in its onset and progress, what may be termed a mechanical predisposition. This may be any deformity or irregularity of the

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articulation, intrinsic or extrinsic, whether congenital or due to injury or disease, that may interfere with free movement of the apposing surfaces of the joint and thus set up friction. When this is present a destructive attrition is established, the rate of progress being determined by its character, the resistance of the tissues and the strain to which the joint is subjected.

As in other forms of disease at the hip-joint the natural tendency is toward flexion and adduction of the limb. This causes an apparent shortening which often becomes actual because of mutual destruction of the head of the

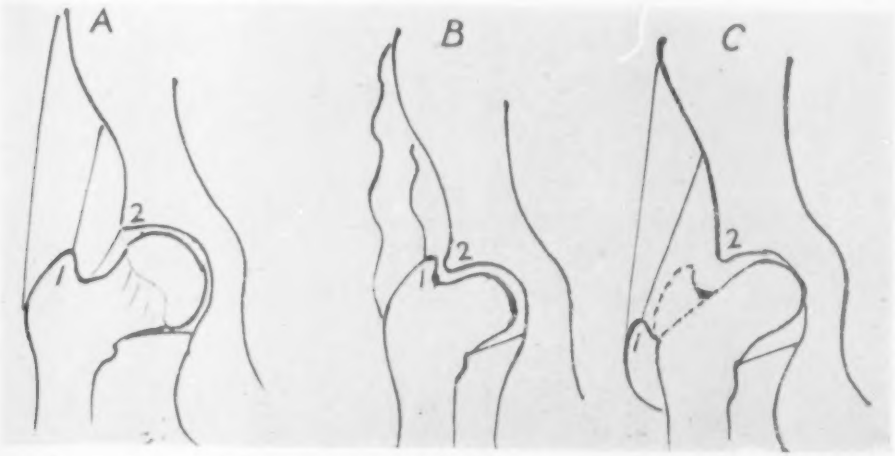

FIG. 2.—A scheme to illustrate the mechanical basis of the reconstruction operation. A. The normal relations at the hip-joint. The anatomical range of abduction is checked by the contact between the trochanter and the acetabular rim, and its extent is determined by the distance between 1—2. B. After excision of the head the leverage of the abductor muscles is lost and the range of abduction is checked by contact of the trochanter and the acetabular rim. Consequently adduction and apparent shortening are almost inevitable. C. The reconstruction operation, which restores the leverage of the abductor muscles and the anatomical range of abduction, thus assuring a symmetrical attitude of the limb.

femur and the upper border of the acetabulum with resulting subluxation. There are several types of deformity, dependent upon the character and duration of the disease. In a general way the classical description is fairly correct, that the cartilage is eroded on the bearing surfaces and is heaped about the periphery like the guttering of a candle. The underlying bone is, however, more often softened than increased in density and may even contain small cavities. In some instances the head of the femur is of a mushroom shape with a corresponding enlargement of the acetabulum. In others there may be an antero-lateral subluxation with but slight distortion, or the head may be depressed upon the neck like an epiphyseal coxa vara. The acetabulum may be surrounded by a ring of new bone formation that almost completely limits motion, and in some instances the disease is of a superficial character with but little deformity of the joint, probably because in such cases motion is limited from the beginning. As a rule the destructive change is greater in the head of the femur than in the acetabulum, where it may be confined to its outer and upper margin, the area of pressure of the adducted femur, a point of importance in the prognosis of the operative result.

Arthritis deformans is not merely a disabling disease in the sense of

limited movement and deformity, but often a very painful one, the chief discomfort being caused by changing from an attitude of rest to activity, as on rising from the sitting posture.

In my experience patients are rarely seen in the early stages of the disease and they have usually received every variety of local and systemic treatment before coming under observation.

FIG. 3.—Typical arthritis deformans in a man sixty years of age, showing subluxation. Operation November 19, 1923. Plaster spica removed December 17. Patient free from pain and walking with crutches on January 7, 1924. Crutches discarded March 19, 1924. The patient was presented at the meeting of the Surgical Society on April 8. The limp was scarcely noticeable. He had no pain and stated that he could walk ten miles.

As a matter of routine one would attempt to remove any possible source of infection, to improve the general condition and to adapt the patient's activities to his disability. Baking, massage, electricity and the like improve the nutrition and relieve in some degree the symptoms. Rest in bed, traction and splinting are temporarily effective because of the relief of the strain of motion and weight-bearing. It is evident, however, that in cases of the type under consideration operative treatment offers the only prospect of permanent relief, and since the symptoms are caused primarily by the friction of the eroded surfaces on one another, the most obvious and generally accepted remedy has been arthrodesis or destruction of the joint. Bony union which is the object is, however, difficult to attain, and usually a long period of fixation by a plaster splint is required to assure satisfactory fixation.

The attitude of election of the limb after arthrodesis is one of slight flexion, abduction and outward rotation, but in a very large proportion of the cases because the fixation is incomplete there is a gradual relapse toward the original attitude of adduction.

These points are illustrated by the reports of later results of arthrodesis from two representative clinics, that of Brackett in Boston (Spiers, *Am. J. Orth. Surgery*, p. 218, 1920) and Page, of London (*Br. J. of Surgery*, July, 1924). Bony ankylosis was present in 26 of the 49 cases investigated (53 per cent.), while the limb was adducted in 37 (75 per cent.).

Minor disadvantages of this operation are that patients require assistance in dressing, while the stiffened joint increases the strain upon the lumbar spine and is thus in some instances a cause of discomfort. Finally, patients often reject an operation that will cause a "stiff hip" even though the motion that they retain is limited and painful.

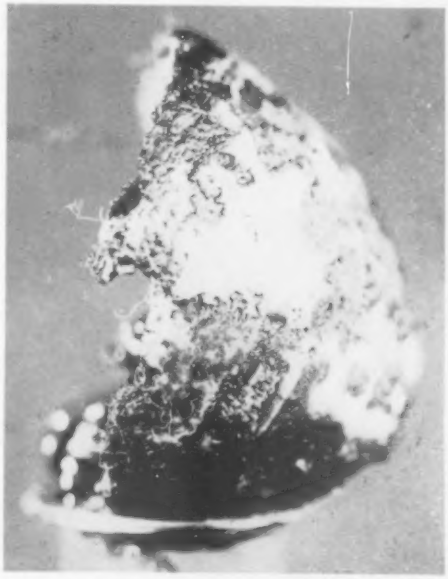

FIG. 4.—Showing the bone removed in Case 1 and the condition of the cartilage.

The operations designed to retain, or to restore motion, require but little comment. "Cheilotomy" to remove osteophytes about the joint is manifestly a treatment of an effect rather than a cause. Excision of the head of the femur while it may be effective in removing friction, almost inevitably will be followed by adduction of the limb because of the loss of leverage of the abductor muscles and the apposition of the trochanter to the acetabular rim. (Fig. 2B.)

It would seem, therefore, that the most practicable, and in most instances preferable, alternative to destruction of the joint, is the reconstruction operation which has already been described to this Society. (ANNALS OF SURGERY, November, 1924.)

In place of excision of the head, its cartilage and the underlying softened bone are removed until fairly resistant tissue is reached, reducing its size to about the diameter of the neck. The trochanter is cut at its base in the line of the angle of the neck and transplanted to the outer side of the shaft.

The removal of the trochanter permits the extremity of the neck to be thrust deeply into the acetabulum where the cartilage is in fairly normal condition. By reducing the size and changing the bearing surface of the femur, one may check mutual friction and yet retain motion, and by restoring the leverage of the abductor muscles prevent adduction deformity.

The technic of the reconstruction operation has not been changed essentially from the original description.

An incision is made from a point one inch posterior to the anterior superior spine downward, then backward, crossing the shaft of the femur about 2½ inches below the apex of the trochanter. The deep fascia is divided and the capsule is exposed in the interval between the gluteus medius

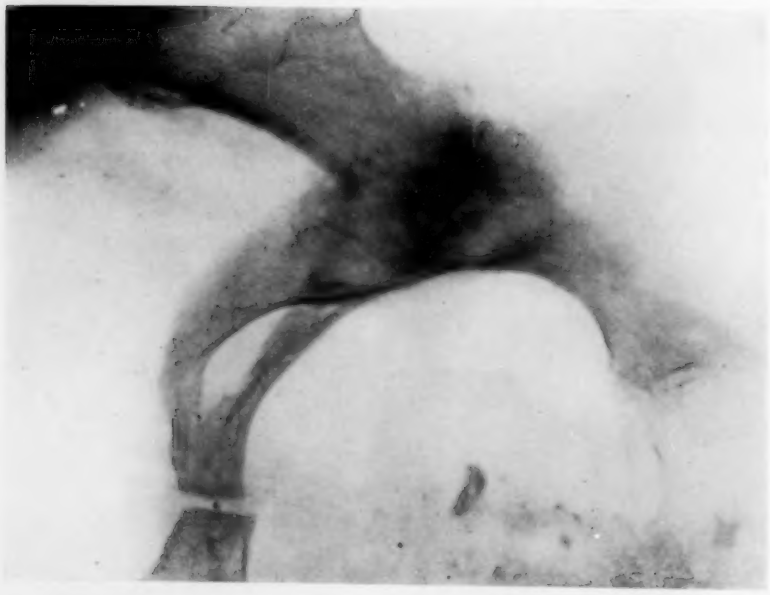

FIG. 6.—Case II. Showing the expansion of the head and the atrophy of the bone. The patient, a woman, forty-eight years of age, had suffered from progressive disability for twelve years. She used crutches. The limb was flexed and adducted. The operation was performed November 13, 1923. She was presented at the meeting on April 12, 1925, free from pain, walking with but slight limp without the assistance of a cane.

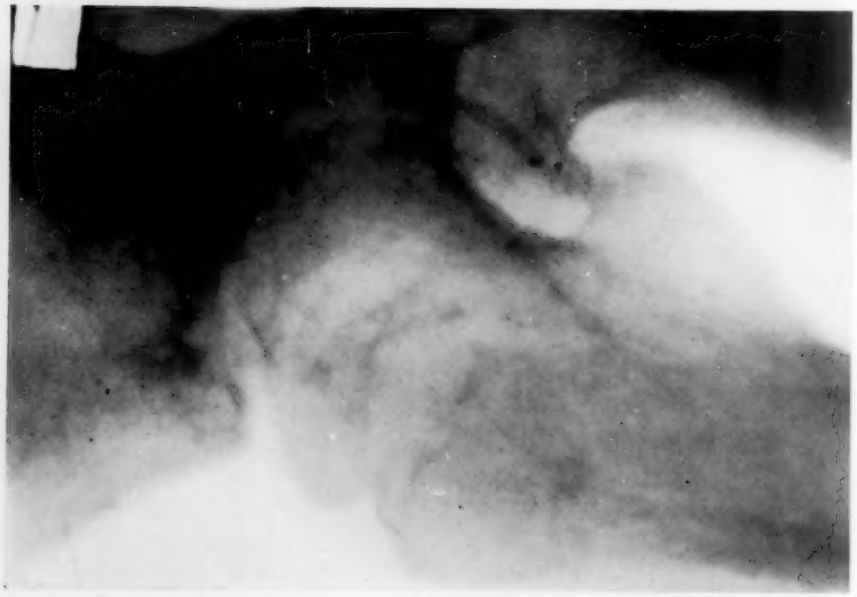

FIG. 5.—X-ray taken ten months after the operation, showing the extremity of the neck and the transplanted trochanter.

and the tensor fasciæ femoris muscles. The trochanter is then cut through at its base in the line of the neck with a wide chisel and with its attached muscles is displaced upward. The capsule is split, and if the osteophytes permit, the head is dislocated for inspection. If not, it is cut through near its base by a curved chisel and removed. The articulating extremity of the neck and what remains of the head is moulded and filed to a smooth, rounded surface. A bed is then made for the trochanter by splitting and turning back a section of the cortex on the outer surface of the femur with the overlying vastus externus muscle. The reconstructed neck is then replaced in the acetabulum and the limb having been abducted about 25°, the trochanter may be brought down to its new site without tension. Here it is attached by kangaroo sutures passed through the muscles. The wound is then closed in layers with the exception for a small drain at its lower margin, and a long plaster spica is applied, fixing the limb in extension and the degree of abduction noted. The drain is removed a few days later. The plaster spica is retained about four weeks, a time which it is assured is sufficient to permit union between the trochanter and shaft. It is of advantage in the after-treatment to suspend the limb in a Balkan frame to permit voluntary and passive movements for several weeks, but in many instances the patient's means do not permit of a prolonged stay in the hospital and he is discharged on crutches with the further support of a short plaster spica if the new joint is still sensitive to movement, weight-bearing being resumed gradually. When this is removed the attitude of abduction and extension must be assured by methodical passive movements or "stretchings" until voluntary control is regained. Systematic physiotherapeutic treatment is, of course, of advantage if it is at command.

FIG. 7.—Case II. After operation.

As compared with arthrodesis, an established surgical procedure, the reconstruction operation is still in the tentative stage. It was devised in

1916 for ununited fracture of the neck of the femur, and was not definitely adapted to arthritis deformans until 1922. In December, 1923, a report on seven cases was presented to this Society and this is now supplemented by eighteen others, performed by myself and associates at the Hospital for Ruptured and Crippled. It is far more difficult than arthrodesis, more especially because the subjects are usually elderly and often obese. Yet in 25 cases there has been but one death, from embolism, an accident that has no relation to the character of the operation. Other than this there has been no serious complication. A direct comparison of the results of the two operations is difficult because in one the primary object is to relieve pain by destroying the joint, deformity and incidental disability being secondary considerations. In the other the purpose is to restore a useful degree of joint function. It is obvious that bony fixation must be the surest remedy for pain caused by friction, for whenever the free range of motion in a joint is restrained from any cause, sudden strain upon the restricting tissues causes discomfort. To this, however, the patient accommodates himself and would rarely exchange even limited motion for fixation. For it is this mobility that checks deformity which is so common after arthrodesis, that enables the patient to sit with comfort and to walk with a fairly symmetrical gait. From a practical standpoint it may be stated that the majority of the patients have been women all of whom, except those under immediate treatment, have been able to resume their household duties, and I do not know of one of the entire number who is disappointed with the result, either immediate or remote. I think, therefore, that the reconstruction operation may be considered as the preferable alternative to arthrodesis for all cases of a favorable type.

PROSTATIC ABSCESS*

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and

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The present communication comprises an analysis of twenty cases of prostatic abscess treated by extra-urethral prostatotomy. In common with others, we lack that contrasting information that would serve to prove our contention, namely, that incision and drainage is the one method of treatment based on sound surgical principles, and insuring a cure in the sense that subsequent morbidity is reduced to the minimum.

We have observed many cases of prostatic abscess that have not been operated upon, and in a considerable percentage of these cases the spontaneous rupture of the abscess into the urethra has been followed by prompt and apparently complete recovery. In the majority of such instances, the abscesses have been submucosal in position, but not all, for occasionally we see complete cure after spontaneous evacuation of abscesses that were primarily situated deeply within the gland.

In cases in which the pus has already broken through the posterior portion of the capsule with the formation of a periprostatic abscess or abscesses, as happened in seven (35 per cent.) of our cases, it is not beyond the realms of possibility that the abscess may form a communication with the urethra and discharge spontaneously, but complete restoration to the normal is unlikely. To say that one has observed cases of prostatic abscess that have recovered completely after the spontaneous evacuation of the pus per urethram, is too often a half truth, for in many instances these individuals have recurrent symptoms after longer or shorter intervals of apparent good health, and it will be found on examination that the pathology consists of a cavity or cavities within one or both prostatic lobes, communicating with the urethra by sinuses or fissures. McCarthy reports a morbidity of twenty-seven per cent. among one hundred and four cases in which the abscess ruptured spontaneously. In the absence of a careful cysto-urethroscopic examination one cannot be sure that the patient is absolutely cured, nor can the permanency of an apparent cure be determined until several years have elapsed after the evacuation of the abscess into the urethra.

The routine employment of the cysto-urethroscope in cases of chronic prostatitis will reveal the cause of the persistency of the infection in an ever-increasing number of instances, to be due to persistent sinuses in

* Read before the Philadelphia Academy of Surgery, March 2, 1925.

the deep urethra remaining from ancient prostatic abscesses. Many of the more aggravated forms of deep urethral infection are due to these chronically infected cavities within the substance of the gland, and it has been our experience that this group of cases constitutes a type which is difficult or impossible to cure.

A patient presented himself at the clinic with a letter stating that he had an aberrant ureter opening on the floor of the deep urethra proximal to the verumontanum. It was found that this individual had a chronic prostatic abscess with multiple sinuses. He returned recently having had a suprapubic prostatectomy done elsewhere, and we now find that the mechanical results are fairly satisfactory, but the patient has constant pain as the result of crippling adhesions in the region of the bladder neck. A second patient had been operated upon three times by way of the perineum for what he believed to have been vesiculitis. We find that he has a labarythine opening lateral to the verumontanum leading into an infected cavity in the left lobe of the prostate. Operations in cases of this kind are, in our experience, followed by very poor results. Incomplete perineal drainage likewise is frequently followed by persistent gross morbidity as is illustrated by our patient who has had two lateral perineal incisions for prostatic abscess, and a third median operation, the latter by ourselves, and as a temporary procedure, until his general condition improves to the degree where a more radical operation is justifiable. This individual has had a small urinary fistula in one of the lateral incisions for years. When pressure is made on the left lobe of the prostate, pus comes in a steady stream from the urethra, from the median and from the left lateral perineal incisions.

Cases like the foregoing are met with very frequently, especially in hospital practice, and it behooves those who advocate palliative treatment for prostatic abscesses to ponder over the chronic invalidism of these individuals, and not to consider a patient cured whose abscess has ruptured into the urethra.

Morton quotes Segond as having collected 114 cases of prostatic abscess with seventy recoveries and thirty-four deaths; the remaining ten cases had persistent fistula. In 102 of these cases, the site of spontaneous rupture of the abscess is given as follows: 35 times into urethra—28 times spontaneously—7 times after passing catheters; 18 times into rectum alone; 21 times into urethra and rectum; 28 times into various regions.

In cases in which the abscess ruptures into the rectum, the event is followed by urethro-rectal urinary fistula, or by a persistent internal incomplete fistula which seldom if ever heals. Cases of this kind eventually come to the rectal surgeon who finds it difficult if not impossible to cure them. It is our opinion that the mortality of prostatic abscess, and especially of the non-gonorrhœal type, is very high in non-operated cases, but the condition is often overlooked and the mortality attributed to renal or other complications.

Any one who takes an impartial view of the situation, is conversant with the literature on the subject, is capable of differentiating between small submucosal abscesses and gross suppuration within the gland proper, and does not

delude himself with the idea that the intra-urethral rupture of an abscess means its complete and lasting cure, will certainly come to the conclusion that the perineal extra-urethral prostatectomy is the treatment par excellence for cases of the type included in this report.

Clinical Types.—There are two main types of prostatic abscess, namely, acute and chronic. It would seem to be superfluous to mention that there is little in common between the course of acute prostatic abscess complicating acute gonorrhœal urethritis, and chronic abscesses. Nevertheless, in many of the systematic writings on prostatic surgery, suppuration in and around the gland is described as a clinical entity. There are, it is true, certain symptoms that may be spoken of appropriately as cardinal, but it is well to remember that the clinical picture may be indefinite, in fact, localizing symptoms may be entirely wanting. The latter, often spoken of as the silent type of abscess, because it gives rise to no symptoms referrable to the genito-urinary tract, is usually of the chronic type, but occasionally the sub-acute prostatic abscess is most indefinite in its clinical manifestations. We saw a patient recently who had been treated for an intermittent fever of undetermined origin for several weeks, before an attack of hæmaturia followed by acute retention of urine directed attention to the prostate gland. Harlan Brooks reports a similar case in which the diagnosis of para-typhoid fever was suspected for a period of four weeks.

Another form of silent abscess of the prostate gland is that associated with or mimicking benign hypertrophy in old men. In one of our cases, both the clinical picture and the physical findings were typical of benign enlargement. The gland in this instance was enormously enlarged symmetrically and there was nothing except an increase in the leucocytic content of the blood suggestive of prostatic abscess. A preliminary cystotomy was done, and this was followed by spontaneous rupture of the abscess into the bladder, so that subsequent exploration revealed only a thin shell of prostatic tissue remaining. An identical case is described by Lydston.

Suppurative prostatitis may be the primary focus for severe blood infection, or it may be merely a secondary manifestation of a pyæmia originating in an osteomyelitis, carbuncle, boil or other primary focus.

An abscess of the prostate may give rise to systemic symptoms resembling actual blood-stream infection, or such symptoms in the early stage of the disease may be toxic in nature, but with subsequent infection of the blood stream denote the presence of a true pyæmia (Case VIII). In the treatment of distant foci of infection, associated with systemic symptoms grave out of all proportion to the degree of local disease, the possibility of metastatic prostatic abscess must be considered even in the entire absence of genito-urinary symptoms.

In the majority of cases of prostatic abscess complicating acute gonorrhœa, the development of gross pus within the gland is characterized by symptoms that demand differentiation only from those arising from intense parenchymatous prostatitis. To this rule, too, there are important exceptions. Two

of our patients complained of intense rectal pain in the entire absence of dysuria, or urinary retention. This was attributed in one instance to the presence of a thrombotic hemorrhoid, in fact, operation for the latter was contemplated. During one week of careful observation, we followed the development of an abscess which had its inception in the cortical part of the gland, but soon ruptured into the prostatico-rectal space and at the time of operation, was pointing into the rectum. The details of this case were as follows:

R. G., age twenty-one, student, admitted to the Methodist Hospital, March 21, 1924. He had contracted an acute gonorrhœa, February 19, 1924. For three weeks he had had pain in the rectum on sitting and walking. He had also had some frequency lately. Rectal examination showed a large fluctuating mass the size of an egg in the region of the left prostatic lobe. T. P. R. normal, W. B. C. 14,400. The urine is laden with pus. March 21, 1924, a perineal (curved pre-rectal) incision was made. A peri-prostatic abscess was opened and drained and about one-half ounce of pus evacuated. The pus was sterile.

The differentiation between intense generalized prostatitis and prostatic abscess of gonorrhœal origin is beset with many difficulties, especially in the early stages when there are no symptoms or šigns, with the possible exception of fluctuation, that are pathognomonic of abscess. Both conditions may give rise to sudden, complete retention of urine; dysuria is common to both conditions; each may run a febrile or an afebrile course; in each, the prostate is enlarged, hot and tender, while leucocytosis is found in association with both processes. There is, however, a difference in the clinical progress of the two diseases. With appropriate treatment, prostatitis, in the absence of gross suppuration, usually shows rapid improvement, which may manifest itself primarily only in a decrease of the leucocyte count. But in the majority of cases, in spite of continued urinary obstruction or marked dysuria, there is some appreciable diminution in size and degree of tenderness of the gland. In suppurative cases, and especially when the abscess is centrally or cortically placed, the leucocytes increase, the subjective symptoms, especially the pain increases, and the gland continues to enlarge and become more tender, while the experienced observer will be able to detect differences however slight, in the consistency of different parts of the organ, and may be able to determine the occurrence of periprostatic suppuration by noting the changes from a well-circumscribed enlargement of the prostate to a more diffuse bogginess in the pre-rectal area. We have found further, that it is usually possible to detect differences in the size of the two lobes in abscess cases, while diffuse prostatitis of the intensely acute types is almost invariably associated with symmetrical enlargement.

Abscesses situated immediately beneath the urethral mucosa, are often unassociated with the tenderness and degree of generalized prostatic enlargement that one expects to find in association with abscesses situated deeply within the gland substance. Chills are rarely associated with prostatitis and almost always denote the presence of abscess.

It is extremely difficult to differentiate between peri-prostatic and intra-prostatic abscess, but if the definition of the prostatic enlargement is replaced by general bogginess, or if it is possible to define a well-circumscribed bulging of the rectal wall, one can be fairly sure that the pus has escaped the confines of the prostatic sheath.

Technic of Operation.—There can be no standard technic for operation by way of the perineum on prostatic abscesses for the reason that no two cases present exactly the same pathology. However, there are certain steps in the operation applicable to all cases and among the most important of these is the complete avoidance of sounds or other guides in the urethra. The object is to make of the operation a thoroughly extra-urethral procedure and the introduction of an instrument may defeat this purpose by rupturing the abscess and thus promoting the complicating factor of fistula. Undoubtedly, the absence of a guide makes the operation a difficult procedure at times. In most cases the exposure of the prostate will be found more difficult than in operation for benign hypertrophy, for invariably there is a considerable distortion of the normal anatomy as the result of peri-prostatic exudate even in the absence of actual periprostatic abscess. In some few long-standing cases, the semi-organization of this exudate, will render the dissection extremely difficult, and in one case our gauze-covered finger entered the rectum while attempting the separation. In some instances, having exposed the apical portion of the gland, one should rest content and open the abscess or abscesses by plunging a curved hæmostat into each lobe, guided by a finger in the rectum and directing the instrument so that its convexity is directed toward the rectum. Care must be taken so that the point of the instrument does not enter the urethra or bladder.

In cases in which the posterior surface of the prostate can be exposed as in operations for perineal prostatectomy, and this includes the vast majority of cases in which the pus is intraprostatic in position, the abscesses are opening by making a vertical para-urethral incision into each lobe, if palpation indicates the presence of pus. When in doubt, we incise. The opening is enlarged by the use of a hæmostat and all septi are then broken down by the use of a finger as a curette. Practically all prostatic abscesses are multilocular. The cavity or cavities are drained by rubber tubes of appropriate size supplemented by iodoform gauze strips if there is a tendency to bleed. The skin incision is closed with silkworm gut sutures; no attempt is made to approximate the deeper tissues. The vast majority of incisions in gonorrhœal cases heal by first intention, except at the point of emergence of the drainage.

We mention the operation of digital opening of prostatic abscesses through an external urethrotomy wound (Dittel's operation) only to condemn it. If we had to choose between this operation and procrastination, we would prefer the latter, certainly for cases in which the pus is confined within the substance of the gland.

Pretorius has modified the Dittel operation by carrying out the same

technic through a small median perineal (boutoniere) incision, under local anæsthesia. The abscesses are then opened trans-urethrally with the finger, for which purpose the patient is given ether or chloroform anæsthesia. The author claims certain advantages for this technic, but the same objection applies, namely, that the abscess is opened into the urethra and the imperfect drainage, especially in peri-prostatic abscesses promotes post-operative morbidity in the form of unobliterated spaces in communication with the urethra.

As regards the association of an external urethrotomy for bladder drainage with extra-urethral opening of the abscess as sometimes advised, we are ready to admit that it may have advantages in some instances, but only in cases with large peri-prostatic collections, and in the presence of other indications that the deep urethral floor will slough. In few of our cases, the addition of bladder drainage by way of a urethrotomy wound would doubtless have been an advantage but certainly not in the majority. We have in only one instance been forced to use the catheter after the operation for relief of retention. Normal urination is promptly and completely reëstablished in most instances.

The operation for peri-prostatic abscess is almost invariably associated with difficulty in displacing the rectum backward; in fact, complete displacement is usually inexpedient, if not impossible. Some degree of separation must be effected, however, and very often in attempting this, the abscess will open spontaneously, and often at the site of the point of the lateral retractor with which the levator ani muscle is being held out of the way. Having found the spontaneous opening with the point of a hæmostat, and this point marks the avenue of approach of the pus to the ischio-rectal space, a finger is placed in the rectum, and under its guidance the opening is enlarged until a finger can be made to enter the abscess cavity. All septi are then broken down within the substance of the gland proper, and the attempt is made to determine the proximity of the upper wall to the floor of the urethra. If the intervening tissue is thin, or if for other reasons it is believed that the abscess is in communication with the urethral lumen, perhaps it is wise to add bladder drainage through a urethrotomy wound rather than to await the spontaneous development of a urinary fistula with the attendant danger of secondary hemorrhage. We have not followed this plan in the present series and the results have been very satisfactory; nevertheless, it would seem the better part of surgical judgment to put the bladder at rest in these advanced cases, and to divert the urinary stream from the abscess cavity. In the type of case under discussion, we have been draining with tube and gauze, but, as already stated, we feel that the latter might well be omitted when used for drainage purposes alone.

Post-operative Treatment.—Hypodermoclysis is used post-operatively in most instances, and especially in cases in which the kidney function has been impaired, or in which septic symptoms have been prominent. The tube and part of the gauze is removed in 48 hours, and the remaining segment of gauze on the following day. In gonorrhœal cases in which abscesses have been

entirely intra-prostatic, the drainage is often removed on the day following the operation. The packing is not replaced except in cases with very large peri-prostatic cavities, and then only for the purpose of keeping the outer wound open. As a rule, we do not irrigate the abscess cavity, although it can do no harm to use dichloramine-T (2–5 per cent.), saturating a narrow strip of gauze and packing the wound lightly. Mercurochrome (2–5 per cent.) is also useful, but the stronger solutions are avoided if there is communication with the urethra. In the latter type of case, catheter irrigations of the bladder and deep urethra are carried out beginning about the fifth day. The use of the catheter presupposes the possibility of instrumentation without difficulty, otherwise the danger of inciting hemorrhage will preclude its use. The bladder is filled with antiseptic solution (permanganate of potash is useful, and some good results have been obtained with irrigations of boric acid followed by Pregyl's iodine solution) and the catheter withdrawn. The patient is then instructed to void by which means the fistulous tract is cleansed with the antiseptic solution. In some few cases we have thought it advisable to give prostatic massages when healing of the wound has been completed. In a few of the very extensive cases, it is necessary to use the deep Kollmann dilator, as a final step in the treatment. As our charts show, the majority of the cases leave the hospital with clear urine; in some few cases it has been necessary to irrigate and otherwise to treat the persistent infection.

Post-operative Morbidity.—Four of the patients in this series were gravely ill, but there was no operative mortality. The most important post-operative complications are, hemorrhage, fistula, kidney break-down and blood-stream infection, each of which is represented in our statistics. It is an interesting fact that of the two hemorrhages complicating the convalescent period, one followed operation on a typical intra-prostatic abscess. The bleeding was extraordinary in that there was massive hemorrhage into the bladder without the slightest bleeding by way of the perineal incision. After attempting to control the bleeding in this case by irrigation and an indwelling catheter, the bladder was opened, when the source of the hemorrhage was found in a spurting vessel in the deep urethra. The latter was packed tightly with gauze strips transvesically, which completely controlled the hemorrhage. This individual lost a large quantity of blood. Five days after removing the packing from the deep urethra, an acute epididymitis, the only instance in the present series, developed, and we did an epididymotomy, with prompt relief. The patient left the hospital in good condition.

PROSTATIC ABSCESS. SECONDARY HEMORRHAGE INTO THE BLADDER

A man, aged twenty-four, was admitted to hospital, August 4, 1923. He had contracted acute gonorrhœa nine weeks ago. Treated for six weeks by his family physician, when following an irrigation of a strong solution of potassium permanganate, he developed severe coccygeal pain. His discharge ceased, but during the following two weeks the pain became worse, and he had marked difficulty in urination. For ten days prior to admission to the hospital, he had complete retention requiring catheteriza-

tion twice daily. Rectal examination showed a large, indurated, smooth, tender mass about the size of an orange, involving the entire prostatic area. W. B. C. 15,300. T. P. R. normal. Urine loaded with pus.

Operation August 6, 1923. Perineal (curved pre-rectal incision). A large abscess involving both lobes of the prostate was opened and drained. Two days later, the patient complained of marked suprapubic pain; the bladder was greatly distended. A soft rubber catheter was passed to the bladder and a great quantity of blood clots washed out. The patient continued to bleed from his posterior urethra into the bladder and the next morning a suprapubic cystostomy was done. It was found that the bleeding was coming from a spurting vessel in the deep urethra, which was packed by strips of gauze. Following this the patient rested very comfortably until five days later, when he developed an acute epididymitis. An epididymotomy was done by which his condition was relieved. The general health of the patient improved and he was discharged from the hospital September 5, 1923, in good condition.

The second post-operative hemorrhage complicated a most remarkable case. The abscess in this case was of gonorrhœal origin, but as a result of instrumental trauma, the patient presented himself for operation with an enormous infected peri-prostatic hæmatoma of rather long standing. Promptly following operation, a urinary fistula developed, no doubt, as a result of instrumental rupture of the urethra prior to the operation. With each voiding thereafter, the urine mixed with a lot of blood came away *via* the fistula, and the patient lost so much blood that re-operation was necessary to divert the urinary stream from the abscess cavity. Accordingly, an external urethrotomy was performed and the abscess cavity repacked. This controlled the bleeding, but some days thereafter septic symptoms which had been present and had disappeared after the first operation, reappeared, and the patient began to complain of pain in the left loin space. This eventually proved to be a lung abscess. After thoracotomy, there was another secondary hemorrhage of such extent that blood transfusion was necessary. The patient recovered but left the hospital with a pneumothorax. The history of the case is as follows:

PROSTATIC ABSCESS. PERI-PROSTATIC HÆMATOMA. PYÆMIA. LUNG ABSCESS

A man, age twenty-five, was admitted to the Pennsylvania Hospital, September 19, 1923. Two months before he had contracted a first attack of gonorrhœal urethritis, for which he was treated by his physician with hand urethral injections and internal medication. For the past two weeks he has had no urethral discharge, but had developed urinary retention together with perineal and renal pain. During the past three days he has had hæmaturia following catheterization. On the day of admission to the hospital, his physician was unable to catheterize him.

Rectal examination showed a large, tender, hot, fluctuating mass in the region of the prostate. His temperature was septic in character, ranging from 104 down to subnormal. His urine was loaded with pus. W. B. C. 16,960.

Operation, July 21, 1923. Perineal (curved pre-rectal) incision. There was a marked œdema of the perineum. The prostate was found to consist of a mere shell of tissue, widely communicating with a large abscess cavity containing a great amount of reddish-brown pus. The rectal wall was œdematous and thickened, and appeared to be on the point of spontaneous rupture. The cavity was drained with a large rubber tube and two pieces of iodoform gauze. Smear and culture of pus showed pure staphylococcus aureus.

Post-operative.—The patient reacted well from the operation and his temperature was normal on the third day, but there was a continual oozing of blood from the wound. Ten days after first operation, it was found necessary to do an external urethrotomy and a retention catheter was placed in the bladder. During all this time the patient was passing his urine through the perineal wound. At this time the writer went off service and did not see the patient until September 4. During the interval from August 1 to September 4, 1923, the patient had run a septic temperature, from 99.4 to 104. The urine was loaded with pus. The blood count showed Hb. 50 per cent., R. B. C. 4,040,000, W. B. C. 12,800. The perineal wound was healed, but the patient had severe pain and tenderness in the left costo-vertebral angle.

Cystoscopy, September 6, showed bladder mucosa normal. Both ureteral orifices normal. Number five catheter passed to right and left kidneys and clear urine obtained. Indigo-carmin (intravenously) appearance, right, ten minutes, left, six minutes. Note made at this time as follows: "I feel sure that renal infection is not the cause of this man's symptoms. Does he have a subdiaphragmatic abscess?" The next day the internist reported heart, lungs and abdomen negative, and suggested the possibility of perinephritic abscess. X-ray of chest at this time was negative. Blood culture showed pure growth of staphylococcus aureus. September 15, internist reported a small amount of fluid in the left base and advised to await developments. During the ten days following, the patient was fairly comfortable. His temperature again became septic in character, and on October 5, the chest was aspirated and thick pus obtained. Smear and culture of this pus showed staphylococcus aureus. Blood showed Hb. 50 per cent., R. B. C. 3,590,000, W. B. C. 18,500. On October 11, Doctor Lee did a thoracotomy and found a lung abscess of the left lower lobe which had opened into the pleural cavity. Following the operation the patient had considerable oozing from the wound which was controlled by horse serum and blood transfusion (400 c.c.). Immediately following the operation temperature became normal and remained so to time of his discharge, February 3, 1924. X-ray at the time of discharge showed a left pneumothorax.

Operation was followed in five instances by perineo-urethral fistula and one perineo-rectal fistula. All of these patients with one exception recovered completely, the single exception being in a patient with tabetic paralysis of the internal sphincter in whom a minute fistula persists.

We have had no instance of recto-urethral fistula, but in two instances the rectum was injured during the operation. In one of these cases, a successful primary repair was done and the wound healed primarily, notwithstanding that the abscess was opened at the same sitting. In a second case the rectal wall was infiltrated and very friable, and our gauze-covered finger entered the viscus in attempting to separate the bowel from the urethra and apical portion of the prostate. The rent was carefully repaired and the abscess immediately opened, but the stitches gave way and the patient developed a recto-perineal fistula. This was closed later under ether anæsthesia and with complete success. Fortunately in these cases the continuity of the urinary tract was intact, otherwise, and especially in the case with the necrotic rectal wall, we should have had recto-urethral fistula to deal with.

One of our recent cases, a man of fifty-five years, had chronic retention of urine for three years prior to operation. He had been practicing self-catheterization for two years, and owing to deficient renal function, severe anæmia and general weakness, was a hazardous operative risk. To complicate matters the clinical features suggested genito-urinary tuberculosis, especially the presence of chronic epididymitis, and while we felt rather certain of the presence of some pus in and around the prostate we

did not suspect the existence of the enormous abscess encountered at operation. The right epididymis was resected for diagnosis and was found to be non-tuberculous. Two weeks later a periprostatic abscess containing a pint or more of foul-smelling colon pus was drained per perineum. This operation was followed by the complete breaking down of the operative area and the development of a urinary fistula. Several times after the operation, the case was exceedingly critical and a fatality was avoided only by the most strenuous stimulative and allied measures.

PERI-PROSTATIC ABSCESS. BILATERAL EPIDIDYMITIS. CONTRACTED VESICAL NECK

Male, age fifty-five years, gonorrhœa nineteen years ago; four years ago began to have urinary obstruction. Following a course of instrumental dilatation, pain was added to the symptomatology without relief of the difficulty. Two and one-half years ago pyuria was noted and since then the symptoms have been getting progressively worse. For the past two years has been using a catheter, the normal function having almost completely disappeared. Withdraws about eight ounces of pus and urine at each catheterization. When the bladder becomes distended there is violent, painful spasmodic contractions of the bladder neck. One year ago a cystoscopic examination revealed three fistulæ opening into the deep urethra.

Examination revealed a right-sided epididymitis involving especially the lower pole and suggestive of chronic abscess. Cord was not thickened. Left epididymis slightly thickened with marked thickening and induration of the intrascrotal portion of the vas. Large nodular mass in the region of the prostate and vesicles. No point of softening felt.

Cystoscopy: "There is a mid-line basal obstruction in the region of the bladder outlet necessitating marked depression of the ocular end of the scope, size No. 18 French, in order to enter the bladder. The latter is normal except for slight inflammation. There is a marked elevation at the outlet (floor). The deep urethra is irregular, badly diseased, with multiple sinuses on the floor lateral to and behind the verumontanum, entering prostatic cavities."

The renal function to phthalein was 30 per cent. elimination in one-half hour (intravenous injection).

X-ray Examination of Chest.—Considerable infiltration of both hiluses with some calcification. Parenchyma clear; urinary tract negative.

The urine was examined for tuberculosis repeatedly, but with negative results. A two-hour phthalein test showed only 20 per cent. output. The urine was persistently low in specific gravity and pus laden. Blood examination: Hæmoglobin, 65 per cent.; R. B. C., 4,224,000; W. B. C., 12,600. Wassermann: negative. Blood chemistry: sugar 0.170, blood urea 24 mgs., creatinine 2.6, uric acid 6.3.

Operation, February 22, 1924. Perineal (curved pre-rectal) incision. In attempting to separate the rectal wall from the urethra a large abscess was opened into. This was drained of about a pint of the foulest sort of colon bacillus pus, the pus resembling in odor and appearance that associated with ancient appendiceal abscesses. The abscess was opened to the left of the urethra, but on passing the finger into the cavity, it was found to be very extensive; the limits were defined with difficulty, but it extended from one pelvic wall to the other, and in an upward direction far beyond the reach of the finger. The prostate and vesicles had sloughed away apparently and the prostatic urethra was lying in the abscess cavity. The pus had not burrowed anterior to the urethra. The extensive cavity was drained with a large rubber tube nine inches in length, supplemented by large pieces of iodoform gauze.

Post-operative.—The patient was profoundly shocked, necessitating repeated infusions of salt and active stimulations. After a preliminary rise, the temperature became normal after two days and remained so for three days, when a chill accompanied by a sharp rise in temperature occurred. This was recovered from in several days. After twelve

TABLE I.

Clinical Symptomatology. Cases of Acute Parenchymatous Prostatitis (Abscess).

Case	Patient	Age	Pain	Retention	Temperature	Chills	Leucocytes	Dysuria	Urethral discharge	Hæmaturia	Pyuria	
											On admission	On discharge
1	D. K.....	24	Perineum severe	Acute complete 10 days	Normal	None	15,300	Marked	Stopped	None	++++	+
2	V. P.....	33	Rectum marked	Partial 12 oz.	Normal	None	11,700	Marked	Stopped	+++	++++	None.
3	A. S.....	40	Perineum severe	None	Normal	None	No record	None	Present	None	++	None.
4	R. W.....	39	Perineum knife-like	None	Normal	None	No record	Marked	Present	None	+++	None.
5	H. M. K...	25	Perineum intermittent, sharp	None	100	None	19,900	Marked	Present	None	+++	None.
6	J. K.....	29	Perineum and rectum severe	Complete for 3 wks. Permanent cath. for 13 days	100⅘	None	23,400	Marked	Present	None	+++	None.
7	D. G.....	24	Rectum and perineum	Acute complete	100⅘	None	15,300	Marked	Present	None	+++	Normal 5 days after op. and has remained so.
8	S. C.....	25	Rectum and perineum severe	Acute complete 3 days	104	None	16,900	Marked	Stopped	Present for 3 days before op.	+++	None for a time, then recurred.
9	D. M.....	31	Rectum moderate	None	101⅘	None	21,000	Marked	Present	None	++++	+
10	M. G.....	24	Rectum and perineum marked	Acute complete 3 days	99	None	No record	Marked	Present	None	++++	None.
11	R. G.....	24	Rectum only on motion severe	None	Normal	None	14,400	None	Present	None	++++	+
12	R. L.....	20	Rectum	None	100.2	None	14,000	None	Stopped	None	++++	+
13	D. M.....	32	Perineum	None	99	None	14,200	Marked	Present	None	++++	None.
14	G.K.....	33	Perineum and rectum	None	99	None	15,000	Marked	Present	None	++++	++
15	R. S.....	31	Rectal	None	99.3	None	18,500	Marked	Present	None	++++	++

TABLE II.

Clinical Data.—Cases of Acute Parenchymatous Prostatitis (Abscess).

Case	Patient	Etiology	Duration of gonorrhœa	Duration of abscess	Time in hospital	Complications	Final result	Morbidity	Culture of prostatic pus	Smears of prostatic pus
1	D. K.....	Gonococcus clear cut history	9 weeks	3 weeks	31 days	Post-operative hemorrhage in bladder-epididymitis	Cured	None	None taken	None taken.
2	V. P.....	Gonococcus from prostatic pus	Denies all venereal infection. No gonococci in urethral smear	2 weeks	27 days	Urinary fistula (temporary)	Cured	None	Sterile	Gonococci.
3	A. S.....	Gonococcus in urethral smear	3 months	2 weeks	10 days	None	Cured	None	None taken	None taken.
4	R. W.....	Gonococcus clear cut history	1 year	7 days	16 days	None	Cured	None	Sterile	None taken.
5	H. M. K...	Gonococcus in urethral smear acute epididymitis	8 weeks	5 days	8 days	None	Cured	None	Streptococcus hæmolyticus	None taken.
6	J. K.....	Gonococcus in urethral smear	8 months	3 weeks	28 days	None	Cured	None	Staphylococcus aureus	None taken.
7	U. G.....	Gonococcus in urethral smear acute epididymitis	8 months	3 days	17 days	None	Cured	None	None taken	None taken.

8	S. C.	Gonococcus smears	2 months	3 weeks	5 months 15 days	Post-operative hemorrhage; urinary fistula; external urethrotomy; lung abscess; empyema	Symptomatically cured pneumothorax	Pneumothorax	Staphylococcus aureus prostatic pus blood and lung abscess	None taken.
9	D. M.	Gonococcus smears, 2 attacks of epididymitis	10 years	3 weeks	15 days	None	Cured	None	None taken	None taken.
10	M. G.	Gonococcus smears	18 months	3½ weeks	17 days	Slight urinary fistula	Cured	2 years later developed laryngeal and genital tb.	None taken	None taken.
11	R. G.....	Gonococcus smears	27 days	1 week		Secondary abscess; incisional	Cured	None	Sterile	Negative.
12	R. L.	Gonococcus smears	4 weeks	1 week	9 days	None	Cured	None	Sterile	None taken.
13	D. M.....	Gonococcus smears	3 weeks	?	32 days	Perineo-rectal fistula	Cured	None	None taken	None taken.
14	G. K.....	Gonococcus smears	1 month	3 weeks	20 days	Temporary fistula	Cured	None	Sterile	Negative.
15	R. S.....	Gonococcus smears	1 month	1 week	17 days	Temporary fistula	Cured	None	None taken	None taken.

TABLE III.

Clinical Symptomatology. Chronic Parenchymatous Prostatitis (Abscess).

Case	Patient	Age	Pain	Retention	Temperature	Chills	Leucocytes	Dysuria	Urethral discharge	Hæmaturia	Pyuria	
											On admission	On discharge
1	J. R.....	49	Suprapubic and lumbar for 6 years.	Retention and incontinence for 1 month. Acute retention with 34 ounces residual	Normal	None	18,600	Marked for 6 years	None	None	+++	No note.
2	W. J.....	37	Shooting pains "all over body"	Acute complete one day	104–very septic; normal 2 days after operation	Yes	43,600	Marked	None	None	++++	++++
3	C. B. F. W.	55	Intense on urination	Chronic for 4 years. Using catheter for 2 years 8 ounces residual	Normal	None before operation.	12,600	Most severe	None	None	++++	+
4	J. R.....	64	Marked on urination	Residual urine 8 ounces	Normal	None	24,400	Marked	None	None	++++	+++
5	R. W.....	43	Perineal	Chronic	99.4	None	19,200	Marked	Present	None	++++	++++

TABLE IV.

Clinical Data. Chronic Parenchymatous Prostatitis (Abscess).

Case	Patient	Etiology	Antecedent history	Duration of abscess	Time in hospital	Complications	Final result	Morbidity	Culture of prostatic pus	Smears of prostatic pus
1	J. R.....	Unknown denies venereal disease	Negative	6 years	18 days	None	Cured	None	Staphylococcus aureas	None taken.
2	W. J.....	Undetermined gonorrhœa 12 years ago	Gonorrhœa 12 years ago	1 day (?)	3 months Total 30 days after operation	Tabes; incontinence of urine; fistula (urinary)	Small fistula remained	Small	B. coli	None taken.
3	C. B. F. W.	Undetermined probably antecedent prostatic	Gonorrhœa 16 years ago instrumentary	Probably 3 years	46 days	Pulmonary tb. Bilat. epididymitis; epididymotomy before prostatic operation	Improved	Some chronic reten-	B. coli	None taken.
4	J. R.	Undetermined	Negative	Probably 4 years	78 days	None	Cured	None	None taken	None taken.
5	R. W.	Antecedent gonorrhœa instrumentation. Two previous operations (Perineal)	Gonorrhœa at age of 14; "50 attacks since then"	Probably for 8 years. First operation 8 years ago	7 days	Fistulæ from previous operation. Periurethral abscess	Improved	Fistulæ	None taken	None taken.

TABLE V.

Case	Patient	Location of pus	Rectal findings	Operation	Secondary operation	Complications
1	D. K.....	Intra-prostatic	Large tender smooth mass size of orange; no fluctuation	Vertical incision of both lobes—drainage	Suprapubic cystostomy. Epididyotomy	Hemorrhage into bladder. Epididymitis.
2	V. P.	Intra-prostatic	Large tender boggy mass in region of prostate	Vertical incision of both lobes; bilateral abscess	None	Temporary fistula.
3	A. S.....	Intra-prostatic	Large tender (bilateral) prostate	Vertical incision of both lobes; bilateral abscess	None	None.
4	R. W.	Intra-prostatic	Hard smooth tender enlargement of both lobes	Vertical incision of both lobes; bilateral abscess	None	None.
5	H. M. K...	Intra-prostatic	Firm smooth tender enlargement of both lobes	Vertical incision of both lobes; bilateral abscess	None	None.
6	J. K.	Intra-prostatic and peri-prostatic	Large soft fluctuating mass in and around prostate (left)	Incision and drainage of abscess, peri-prostatic	None	None.
7	D. G.....	Intra-prostatic	Enlarged smooth tender firm left lobe	Vertical incision of left lobe; unilateral abscess	None	None.
8	S. C.....	Intra-prostatic and peri-prostatic	Large fluctuating mass tender in region of prostate	Incision and drainage of enormous peri-prostatic abscess	External urethrotomy. Thoracotomy; transfusion	Secondary hemorrhage; septicæmia; lung abscess.
9	D. M.	Intra-prostatic	Right lobe small firm; left lobe large tender firm	Vertical incision left lobe; unilateral abscess	None	None.
10	M. G.	Intra-prostatic	Large tender tense prostatic mass	Vertical incision left lobe; unilateral abscess	None	Temporary fistula 2 years after operation developed tb. genital, laryngeal.

11	R. G.....	Peri-prostatic	Fluctuating mass size of egg in region of left prostatic lobe	Incision and drainage about ½ ounce of pus	None	None.
12	R. L.	Peri-prostatic	Large tender firm mass in region of right lobe of prostate	Incision and drainage about ½ ounce of pus	None	None.
13	J. R.	Intra-prostatic	Large tender prostatic mass	Vertical incision of both lobes; bilateral abscess	None	None.
14	W. J.	Peri-prostatic	Large suprapubic mass—pelvis filled with soft mass	Incision and drainage about 1000 c.c. pus evacuated	None	Fistula (small) tabes dorsalis; tabetic bladder.
15	C. B. ..... F. W.	Peri-prostatic	Large irregular non-tender nodular mass in prostate and vesicular areas	Incision and drainage about 500 c.c. of foul smelling pus evacuated; epididymectomy	None	Chronic retention of urine.
16	J. R.	Intra-prostatic	Enormous bilateral symmetrical enlargement diagnosed hypertrophy	Suprapubic cystostomy	Exploration of prostatic	None.
17	D. M.	Intra-prostatic	Large tender fluctuating mass in left prostate	Vertical incision left lobe	Repair of rectum	Fistula (recto-perineal) temporary.
18	R. W.	Peri-prostatic	Large right lobe mass firm tender	Midline perineal incision local anæsthesia	None	Fistulæ from present and previous operations.
19	G. K.....	Intra-prostatic	Large symmetrical tender firm mass	Incision and drainage of both lobes; 5 c.c. of pus from right lobe	None	Temporary fistula.
20	R. S.	Intra-prostatic	Enlarged tender firm irregular; vesicles involved	Incision of both lobes no gross pus found	None	Temporary fistula.

days of normal temperature, the latter again rose to 104 and for four days the patient was very septic. Soon after operation voiding was entirely by way of the perineal wound. The convalescence was extremely "stormy" and at times the prognosis seemed hopeless, but gradually the fistula closed. The general health of the patient improved and he was discharged from the hospital March 24, 1924, in a fair general condition, but with almost complete retention remaining. The latter persisted despite urethral dilatation. On November 11, 1924 (nine months after the perineal operation), the median bar obstruction at the bladder outlet was removed by means of the cautery punch. Normal urination was promptly reëstablished and at the present writing, fourteen weeks after operation, the stream is large and forceful, there is no residual, and the patient is able to retain the urine for four-hour periods.

One of the patients developed laryngeal and prostatic tuberculosis two years after the incision and drainage of an intra-prostatic abscess of gonorrhœal origin.

We have found in gonorrhœal cases that the infection is easily controlled after operation, in the majority of instances very little if any treatment for persistent infection is necessary after the patient leaves the hospital.

To Recapitulate.—Of the 20 cases herewith reported, 18 (89.4 per cent.) may be classified as cured. Three of the patients had some complication, necessitating further operative procedures. One of these had severe bleeding into the bladder and epididymitis; another had a fistula; while the third had a severe bleeding from the bladder, staphylococci pyæmia, and lung abscess (with secondary hemorrhage from the lung, necessitating blood transfusion).

Two patients were classified as improved but not cured; one (a tabetic) had a urinary fistula; a second had had a small persistent fistula in a lateral perineal incision for years.

CONCLUSIONS

1. Prostatic abscess is often an extremely serious disease.
2. Unoperated cases frequently end fatally or in chronic invalidism.
3. Abscesses of non-gonorrhœal origin are far more serious as a class than those complicating acute gonorrhœa.
4. The clinical differentiation between intra-prostatic and peri-prostatic abscess is often impossible.
5. The treatment of choice is perineal extra-urethral prostatotomy.
6. Diversion of the urinary stream by means of an external urethrotomy is advisable in cases complicated by large peri-prostatic collection and especially in chronic cases.
7. Leucocytosis is one of the most important diagnostic signs.

SPASTIC OBSTRUCTION TO THE URETERS

By Thomas N. Hepburn, M.D.

of Hartford, Conn.

In trying to explain the now quite common finding of ureteral obstruction, the investigator can not but be surprised that so little consideration has been given to the possible influence of the circular muscle rings found in the walls of the drain pipes of the urinary system. In 1911, Max Brödel drew an excellent diagram of these muscle rings, published by Kelly and Burnam in their work on "Diseases of the Kidney, Ureter and Bladder." (See Fig. 1.) It should be noticed that these ring-like bands of muscle occur at, and may possibly be, the cause of the normally narrow portions of the drainage system of the kidneys.

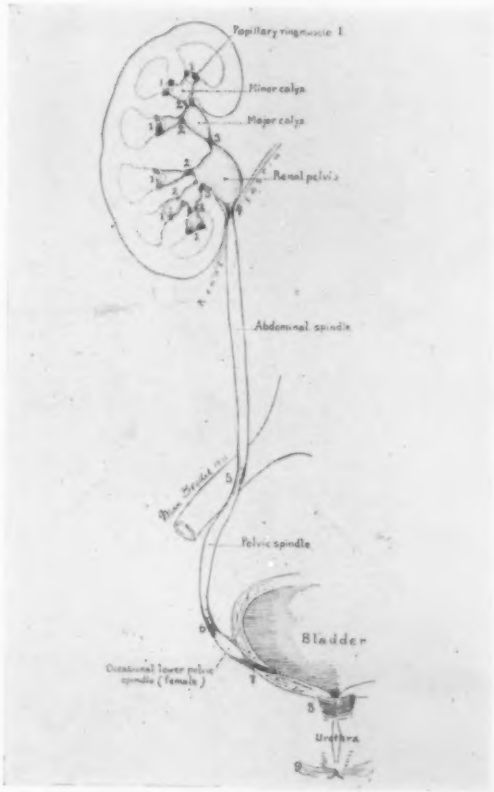

Fig. 1.—Diagram of the urinary tract in women, showing a series of well-defined compartments separated from one another by little ring muscles which represent thickenings of the circular coat in these places. The condition has been shown considerably accentuated in order to illustrate the point. The first ring muscle (1) is seen encircling the papillæ; the second (2) at the neck of the minor calices; the third (3) at the neck of the major calices; the fourth (4) between pelvis and ureter; the fifth (5) at the crossing of the iliac vessels; the sixth (6) in the broad ligament; the seventh (7) in the wall of the bladder; the eighth (8) at the internal sphincter; the ninth (9) at the external urethral orifice. This is no ring muscle, although there is a narrowing of the lumen at the meatus. As the diagram shows, the ureter has several spindle-shaped dilatations between these ring muscles. The most marked constriction is found at 4; its narrowness is accentuated by the renal fascia passing over the ureteropelvic junction, as shown. (After Kelly-Burnam.)

For the sake of simplicity, it is well to consider the renal pelvis and calices as the upper end of the ureters and the trigone and urethra as the lower end of the ureters. Embryologically, they are derived from the Wolfian duct and are quite distinct from the bladder, which is derived from the alantois.

Physiologically, the ureters conduct the urine from the renal pyramids by a peristaltic action similar to that of the alimentary tract. These contractions start in the first rings of circular fibres around the pyramids and travel downwards at the rate of 2 or 3 cm. a second and recur every 10 or 20 seconds—depending upon the rapidity of urinary secretion. Whether this contractile impulse, or peristaltic action is dependent on the ureteral con-

tent, or whether it is stimulated by some substance in the circulatory system, or whether it is dependent upon a nerve supply are very interesting studies.

The ureter has been seen to contract after the kidney has been removed, so its peristalsis is certainly not entirely dependent on its content. Small pieces, when removed from the body, have been seen to contract, so that it is

FIG. 2.—Pyelogram of bilateral megalo-ureter due to spasm of interureteric muscle.

not entirely dependent on its nerve supply, although cutting the splanchnic nerves decreases the contraction and stimulation of the cut distal end and increases it. Cutting off the blood supply to the ureter diminishes the contraction of the ureter, but whether there is any specific element in the blood that stimulates or diminishes these contractions is not proven.

With the above considerations in mind, let us see if spasm of the ureter may not be a possible explanation for many cases of intermittent and chronic

obstruction to the ureter. Is it not possible that the circular muscle bands depicted by Brödel may be either overdeveloped or thrown into spasm, under circumstances which we poorly understand, so as to completely obstruct the urinary flow for a long enough time to give symptoms of hydro-ureter and kidney?

1. The first observation bearing on this hypothesis is that obstructions to

FIG. 3.—X-ray of patient with 26 F. rectal tubes up ureters—the ends coming out through the suprapubic incision.

the ureter are most commonly found at the following places: (*a*) The uretero-pelvic junction; (*b*) at the point where the ureter goes over the iliac vessels; (*c*) in the broad ligament portion in females; (*d*) and in the intramural or trigonal portion. Every one of these places is the location of a circular muscle band. The commonest point of obstruction is in the intramural portion. Not only is this group of circular fibres largest here, but

they here practically become a part of the trigone, and the two ureteral openings are connected by the interureteric muscle band.

2. Next let us bear in mind the observation of every cystoscopist that with a highly sensitive bladder, the most frequent cause of failure to catheterize the ureters is spasm. This spasm may so contract the meatus that even the tip of an olive bougie will not be admitted. The obstructing spasm is more often found in the intra-mural portion. From the bladder up, the points where the catheter stops are apt to be at the location of the circular muscle bands, noted by Brödel.

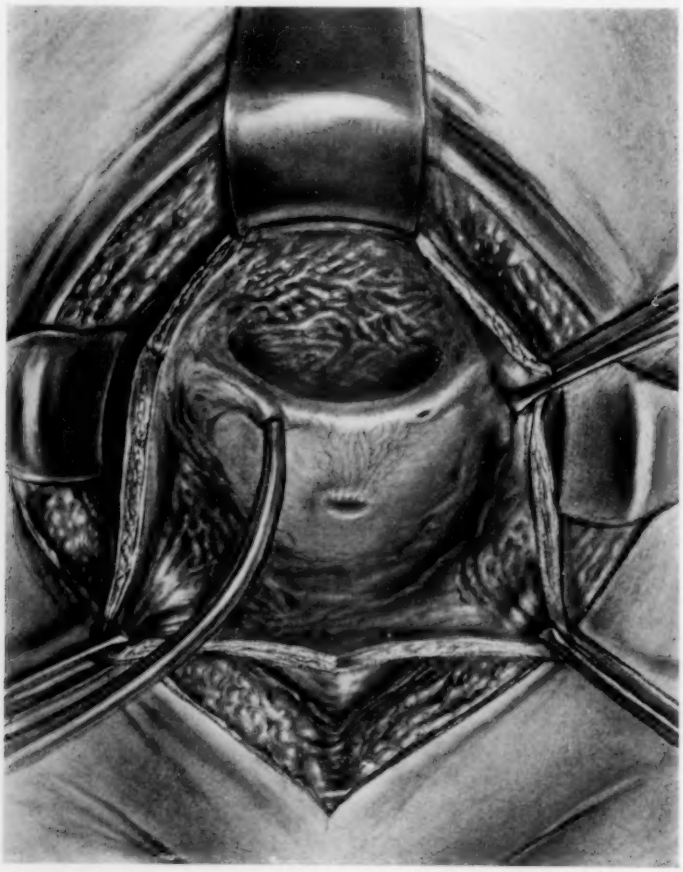

FIG. 4.—Patient in Trendelenburg position. Bladder widely opened. Flexible bougie dilating ureter.

3. After the catheter is in position, it has been observed that they at times drain no urine. This again is seen in the hysterical type of patient. I have noted this phenomenon in patients with marked polyuria and a catheter clear up in the renal pelvis. In such cases there must be either a cessation of urinary secretion or else an obstructing spasm of the muscle bands controlling the outlets of the minor or major calices. These patients complain bitterly of all the pain seen with hydro-nephrosis, and after a time the catheters begin to drain profusely, and the pain is relieved.

4. Again, it is a common experience of those making uretero-grams and pyelograms (when using the gravity method of injecting the fluid and a catheter only part way up the ureter) to find that, with some patients, the fluid will not go up the ureter unless a syringe is used, thus showing an obstructive action to even a liquid dilator unless introduced at a dangerous pressure and rapidity.

5. The distressing pains after ureteral catheterization are those of hydronephrosis. Nervous patients may take days to recover from the symptoms of ureteral obstruction, where spasm due to trauma is the most reasonable explanation.

6. The finding of bilateral ureteral obstruction—especially when that obstruction is in the intra-mural portion of the ureter, is in keeping with the spastic theory—especially when there is hypertrophy of the interureteric muscle—seen with bilateral ureteral obstruction, causing the so-called megalo-ureters. (Fig. 2.)

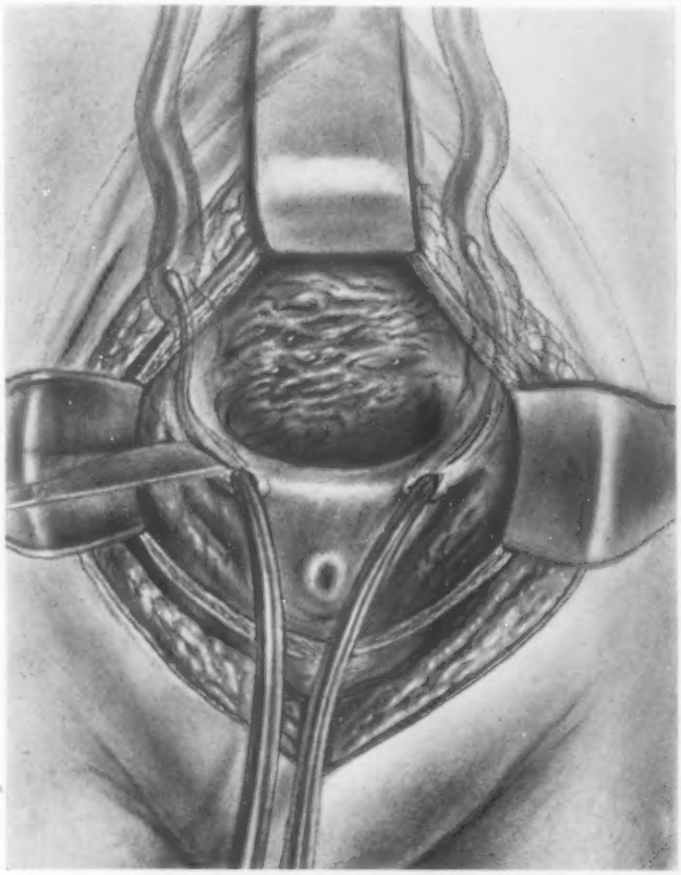

FIG. 5.—Both ureters dilated with bougies. Incision made through muscle fibres of ureteral walls down to mucosa, as in pylorospasm.

Several years ago I became convinced that spasm at the lower end of the ureters was a cause of some of the bilateral obstructions, and published an operation devised to overcome it. (See *Surgery, Gyn. and Obs.*, vol. xxxvi, p. 368.) This operation consisted in opening the bladder suprapubically, dilating the intra-mural portion of the ureters up to 26 F., cutting through the muscle wall of the ureter in order to weaken its contractile power, and introducing 26 F. rectal tubes up each ureter, bringing the ends out through incision. (See Fig. 3.) These, I let in place for ten days, utilizing them for renal lavage. The relief from pain and improvement in renal function as a result of this procedure was immediate and marked. In one case, however, I found on cystoscopy a year after the operation, that the ureteral openings were again contracted, and the interureteric muscle stood out in marked hypertrophy and spasm—a factor the significance of which I had not before noted.

The trigone, as said above, is embryologically a part of the ureter and not of the bladder. It is a highly sensitive body and its interureteric muscle should be looked upon as controlling the two inlets of bladder. It is easy to study with the cystoscope and can be easily approached surgically through the bladder. Therefore, spasm of this portion of the ureter becomes a special interest in view of its possible surgical relief.

History.—The history of these cases of spastic interureteric muscle obstruction is interesting. It may occur at any age. I have seen it in a number of children. A history of recurrent pyelitis in children, especially if associated with difficulty in voiding, should arouse suspicions of spastic obstruction. In adults, be suspicious of interureteric muscle spasm when you get a history of renal colic following any unusual physical strain. One of my friends holds a responsible executive position. Following an important committee meeting or speech, he is most apt to have renal colic. Repeated cystoscopies and X-rays reveal no stones, and his interureteric muscle is distinctly hypertrophied. These patients are apt to be thin and nervous. Whether this is the result of the disability or is associated with a high-strung nervous mechanism, I do not know. Certain, it is, that its acute symptoms are apt to manifest themselves when the patient has become exhausted either by emotional or muscular fatigue. As a rule there is a history of pain in the renal region. This pain may be chronic, dull, and intermittent in character

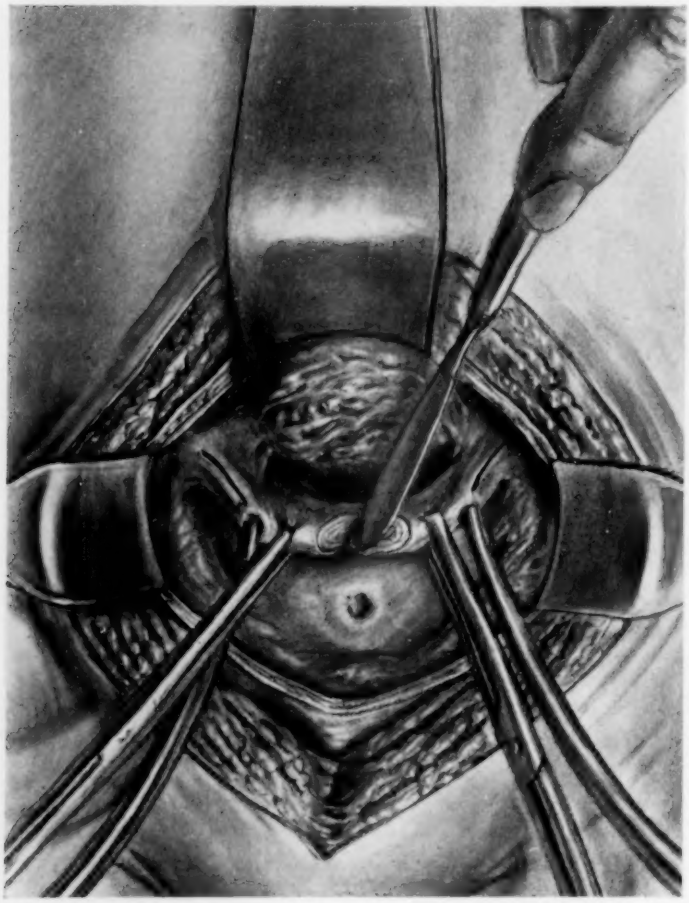

FIG. 6.—The interureteric muscle is severed down flush with the bladder wall behind.

or very acute. Frequently, the pain alternates from one side to the other. It may be in the course of the ureter. If right ureteral, the appendix is almost sure to be removed. At times the pain is pelvic in character, and if the sufferer is a female, she is quite certain to have her uterus or adnexia attached surgically. Should the patient be fortunate enough to fall in the hands of a urologist, there is little doubt that he or she will begin a career of dilatation with bougies for ureteral stricture. It should be kept in mind, that ureteral obstruction causing the most extreme dilatation of ureters, renal pelves and calices may exist without history of pain. The patient's first symptoms are advanced nephritis and signs of deficiency of renal function. That the patient is other than an ordinary nephritic case may not be suspected, unless there is enough infection to cause pus cells in urine, thus suggesting a cystoscopic examination.

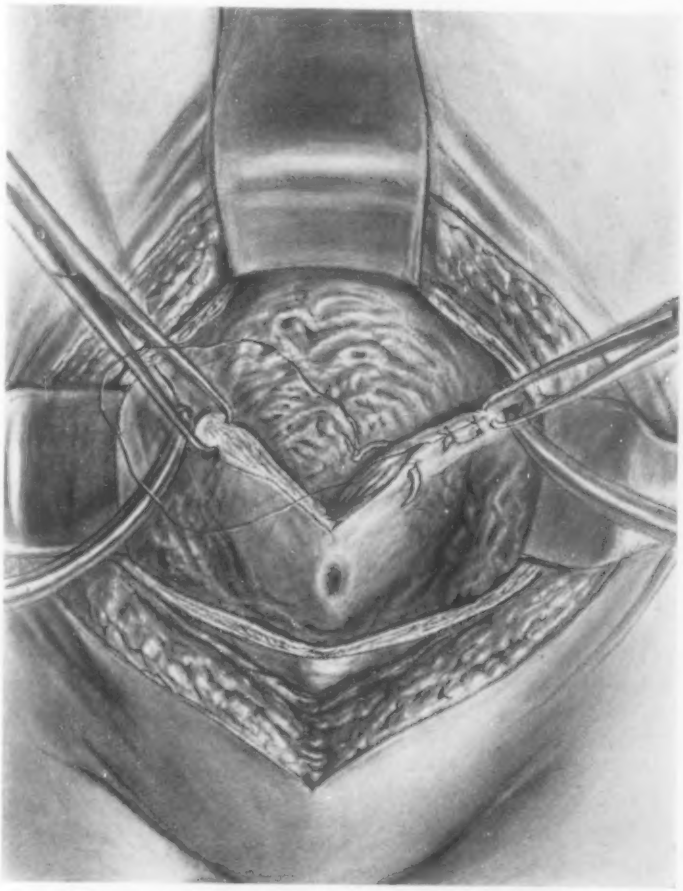

FIG. 7.—Stitching incision through interureteric muscle antero-posteriorly, so that the muscle cannot reunite.

Diagnosis.—The diagnosis of ureteral obstruction due to interureteric muscle spasm is made from the history, the cystoscopic appearance of the interureteric muscle, and from the ureterograms. The cystoscope will show hypertrophy and spasm of the interureteric muscle. This may be associated with hypertrophy of the whole trigone, and marked trabeculation of the bladder wall. In such an extreme case the diagnosis is easy. Others are very hard to differentiate from the normal spasm of a well-developed interureteric muscle.

The pyelogram must show dilatation of the ureter down to the bladder wall. If the dilatation is bilateral, the diagnosis is more certain.

Treatment.—The treatment of this condition depends on its etiology and the degree of its development. Should it be due to fatigue and of mild degree, certainly rest and good hygiene are indicated. Should it be mild in degree and associated with either congenital or acquired stricture of the ureter, dilatation with bougies is indicated. Should it be mild in degree and associated with sexual reflexes—as I have seen in a number of women who have renal colic following undesired or unsatisfactory coitus, it is possible that the husband may be instructed in the tact and art of sexual approach with a happy result. When the condition is well developed, I believe the most logical and simplest procedure is surgical.

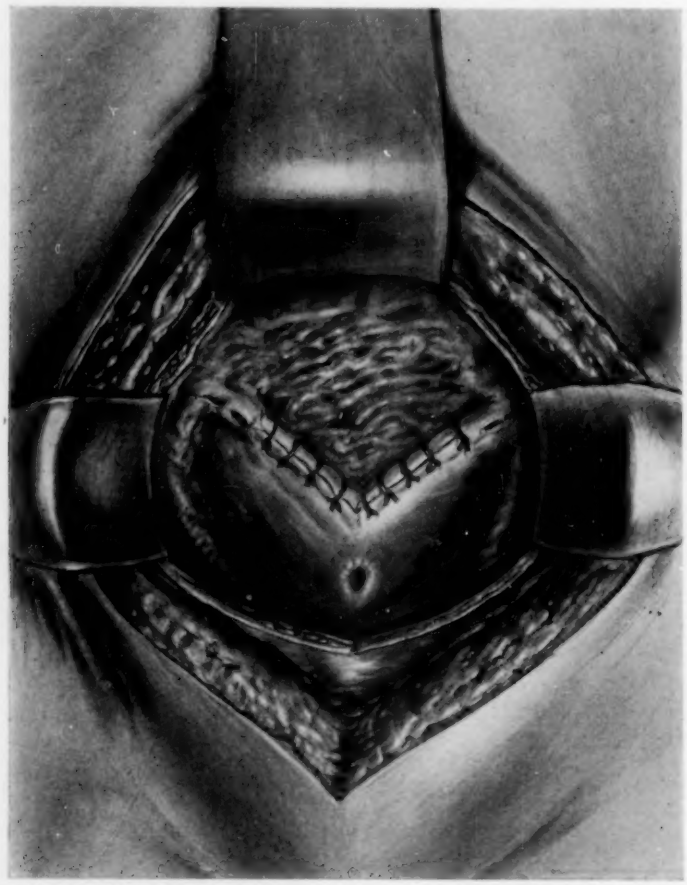

FIG. 8.—Appearance of the bladder after the plastic operation is completed. The bladder is then closed tight with a double row of No. 2 chromic catgut sutures and a cigarette drain put down to the bladder incision.

Operation.—The following operation I have now done a number of times with very satisfactory results. The illustrations (Figs. 4, 5, 6, 7, 8 and 9), for which I feel deeply grateful to Miss Lovett, a pupil of Max Brödel, will, I think, explain the surgical procedure without further description.

In the majority of cases the procedure illustrated in Fig. 9 is unnecessary. I have had to do it only four times. Ordinarily, the bladder is closed tight. A cigarette drain to the bladder incision is removed on the fourth day, and the patient goes home within two weeks without a wound dressing.

Since reading the work of Doctor Hunter, of Australia, on spastic para-

plegia by severing sympathetic nerves, and the application of this principle to stomach surgery for pylorospasm, I have wondered whether some operation for severing the hypogastric nerve might not be applicable to spasm of trigone. I hope to see some experimental work along this line.

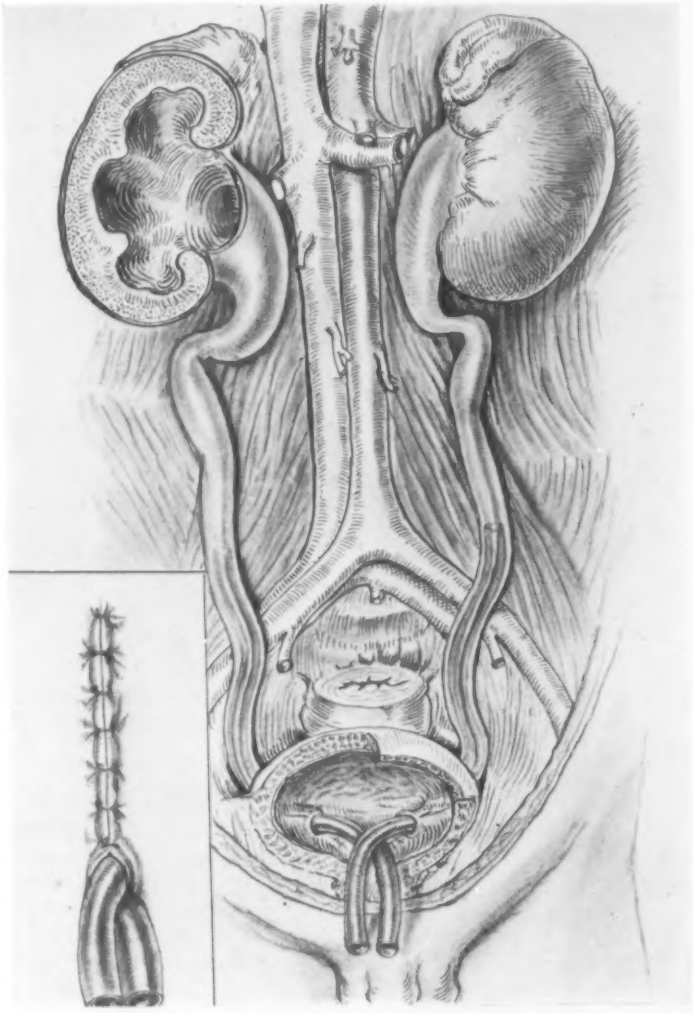

FIG. 9.—Where there is marked infection and dilatation of renal pelvis and calices, it may be wise to leave 24 F. rectal tubes up the ureters, bringing them out suprapubically. This assures immediate relief from back pressure and permits of frequent irrigations. These tubes I have always removed by the tenth day.

SUMMARY

1. Spasm of the ring muscle bundles described by Brödel is a frequent cause of ureteral obstruction.

2. The trigone controls both inlets of the bladder by action of the interureteric muscle—each end of which encircles the ureteral openings. Spasm of this muscle can be definitely diagnosed as a cause of ureteral obstruction, and may be successfully treated surgically.

3. Cutting the interureteric muscle and closing the cut antero-posteriorly in conjunction with dilatation of the intra-mural portion of the ureters with bougies is the best treatment for those cases that will not yield to hygiene or dilatation with bougies.

TORSION OF THE SPERMATIC CORD

REPORT OF TWO CASES WITH REVIEW OF LITERATURE

By Max Thorek, M.D.

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SURGEON-IN-CHIEF TO THE AMERICAN HOSPITAL.

Mechanical strangulation of the spermatic cord by torsion on its long axis may interfere sufficiently with vascularization so as to produce a sphacelous condition in the cord itself, in the testicle, or in both. The condition probably occurs with much greater frequency than a perusal of the literature would suggest; but owing to its simulating other conditions the correct diagnosis is often not made unless operation is carried out.

The first case seems to have been reported by Delasiauve [1] in 1840. Vanvaerts [2] in 1904 collected 44 cases; Rigby and Howard,[3] reporting in 1907, could only find 40 cases; but O'Conor [4] in 1919 found the number of cases increased to 124. In recent times the condition is much more frequently reported; thus Keyes and his associates [5] in the Bellevue Hospital, N. Y., found 7 cases in the records there. Clute [6] observed 3 personal cases, and in my own practice in the American Hospital, Chicago, I have operated the same number, one of which cases I reported in 1919.[7]

Since then, in addition to the authors referred to and the two cases now reported, I find in the literature that cases of torsion have been reported by Papin,[8] Murray,[9] Powell,[10] Begg,[11] Taylor,[12] Nash,[13] Pizzagelli,[14] Carraro,[15] Lynn,[16] Rodd,[17] Borchgrevinck,[18] Matronola,[19] Pignatti,[20] Butler,[21] Barney,[22] Mouchet,[23] Scaglione,[24] Mauclaire and Vigneron,[25] Beaugendre,[26] McKay,[27] Parmenter and Counterman,[28] Weitz,[29] Bardy,[30] Nicolich,[31] and Battazzi.[32]

The frequency with which the condition is now reported shows that it is no rarity, and that its possibility is more often thought of and looked for than was the case formerly.

The histories of my two further cases are given below:

Case I.—Mr. William T. G., age thirty-three years; American; married; no children; a lather by occupation. Admitted to American Hospital, December 25, 1924, complaining of pain in left inguinal region and an enlargement which patient has noticed in the left side of scrotum. His present trouble began last monday afternoon after he had been working rather hard all day, and was manifested by distress in the left lower quadrant of the abdomen, radiating to left inguinal region, scrotum and back. At first the pain was tolerable, but gradually increased in intensity, and has continued unabated until his entry into hospital. On Thursday, prior to the onset of the pains, patient was constipated but had no vomiting. There was nausea. On the day prior to the admission of the patient to hospital his bowels moved with an enema. When admitted his left lower abdominal segment was generally sensitive. Left scrotum bulging. Left testicle extremely painful on slight pressure. Some tumefaction in left inguinal region.

Operation.—Incision over left inguinal region and spermatic cord exposed. The cord was bluish in color and very œdematous. At the point of exit of the cord from the external inguinal canal marked constriction was observed. The testicle was then

traced down to the scrotum and brought into the wound. It also was considerably enlarged and the blood-vessels on the unopened tunica vaginalis were extremely engorged and tortuous. The surrounding tissues by reason of transudation were very much swollen (Fig. 1).

The cord was found twisted a number of times around its axis (two and one-half complete turns (Fig. 2). Attempts to untwist the cord appeared futile by reason of the apparently necrotic and adherent condition of its component structures as well as of the testis. An orchidectomy was decided upon, which was done in the usual manner with the electric-cautery. The cord, after being severed, was then dissected away from

FIG. 1.—Torsion of spermatic cord. Showing general œdema of parts surrounding the cord.

its surrounding structures and ablated. Figure 2 shows the twisted condition of the cord. The testicle was about three times its normal size.

A gross study of the specimen removed showed the vas deferens, the deferential artery thrombosed and a complete clotting of the pampiniform plexus and spermatic artery. The split testis showed its greatest portion as well as most of the epididymis in a process of dissolution.

Microscopic examination of the cord showed the usual manifestations of thrombosis and œdema. In the testicle proper the stroma was very much infiltrated with fluid and cellular elements. The parenchyma of the testis itself showed all degrees of congestion and cell destruction.

The patient left hospital at end of fortnight completely cured.

CASE II.—Mr. F. R. McQ.; thirty-two years of age; married; salesman; family history negative; admitted to the hospital, January 3, 1923, complaining of pains in the left scrotum along the left inguinal region, small of the back and perineum. Pains came on suddenly while patient was stooping over a trunk which he had a short time before lifted to a considerable height, the effort requiring much strain. Previous to the present illness the patient has always been well and never noticed any bulging in the inguinal canal nor had he suffered any inconvenience about his genital tract. He was a well-developed, stocky-built man of moderate height, weighing about 170 pounds. When admitted his facial expression displayed agony. Examination of the head, neck, thorax and abdomen negative, except a very slight tumefaction in the left inguinal region and

stony hardness of the left testicle. No discharge from urethra. No tympany or rigidity anywhere in abdomen. Bowels of patient acted normally until the time of admission to the hospital. Some suppression of urine has been disclosed, however.

By reason of the increasing agonizing pains of which the patient complained, operation was decided upon on the night of admission of the patient to the hospital. Exposure of the affected parts revealed no hernia, but a marked torsion of the spermatic cord with swelling and infiltration of the testicle. Attempts at detorsion, supplemented by hot packs to restore circulation in the strangulated tissues, proving of no avail (about 25 minutes' trial), orchidectomy with high ablation of the cord was practiced. Patient

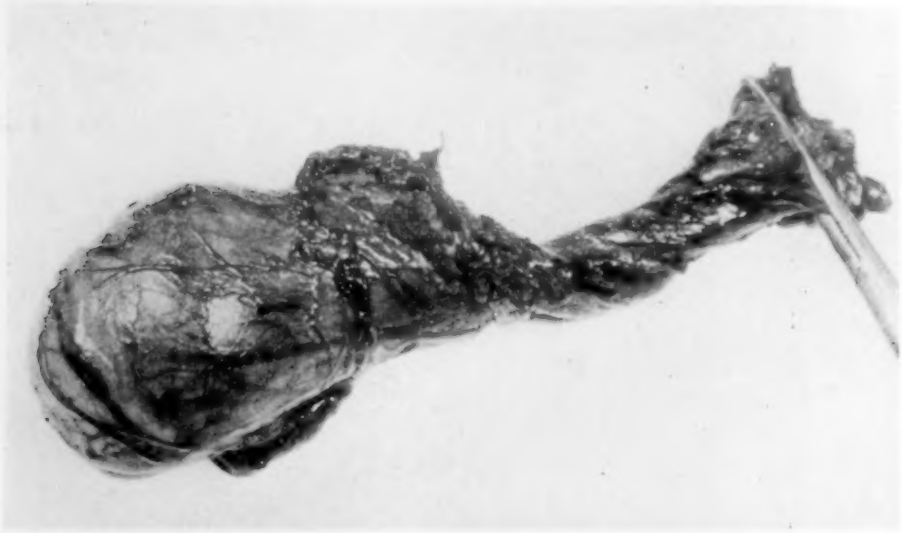

FIG. 2.—Torsion of the spermatic cord. Cord twisted three times on its longitudinal axis.

made uneventful recovery. Cross-section of affected tissues supplemented by microscopic study showed apparent destruction and impossibility of restoring the affected tissues. Strangulation had apparently existed for about 36 hours.

The general facts in both these cases correspond to those observed in other cases reported in the literature. In the first case the torsion had evidently commenced several days before the patient entered hospital. In the second case the torsion was of about 36 hours' standing.

The illustrations which I give of the first case are valuable inasmuch as they clearly show the gross pathology of this interesting condition and supplement the verbal descriptions given in most recorded cases. Both macroscopic and microscopic examinations in both cases justified the orchidectomy imposed by the clinical findings. It would have been impossible for these tissues to regenerate.

In the second case attempts to untwist the cord and restore the circulation necessitated orchidectomy. Although some authors seem to consider that orchidectomy is not called for in a torsion of less than 72 hours' duration, I do not think that any arbitrary conditions can be laid down and the clinical findings (after a fair attempt at detorsion) must be the surgeon's guide, no matter how long the torsion may have lasted.

Statistical.—Torsion of the spermatic cord may occur at any age, but is more usual in the years immediately following puberty. About 75 per cent. of the recorded cases occurred before the age of twenty years. Several cases have been observed in young infants. In Begg's case [11] the condition probably existed at birth and the child was operated at eleven days old. Taylor's patient [12] was only two days old when operated and Nash's patient [13] one week old. In both cases now reported by me the patient was more than thirty years old.

In the 124 cases collected by O'Conor, the torsion occurred on the right side in 70 and on the left in 54. The predominance on the right side coincides with the predominance of undescended testes on this side. Seventy-two of the cases occurred with incompletely descended testes and 52 with fully descended testes. Papin [8] indeed suggests that the testes in all or nearly all of these cases have at some time been ectopic.

There are two well-recognized types of torsion of the cord, the acute and the recurrent. The acute type is that in which the symptoms are so fulminating that a wrong diagnosis is often made and the true condition only discovered at operation. The recurrent type is more likely to be correctly diagnosed if a careful history is taken and epididymitis ruled out. In this type the symptomatology is not so severe as in the acute type and the condition subsides after spontaneous untwisting—until the recurrence of a new attack.

Etiology.—Several etiological factors have been mentioned in connection with the cause underlying or predisposing to spermatic cord torsion. According to Sebileau and Descomps [33] torsion is specially favored by abnormal mobility of the testicle or by its abnormal pediculization; when the testicle is ectopic there is usually abnormal mobility. The spermatic cord being fixed to the abdominal wall by its superior pole cannot well twist except by the action of the suspended testicle, and according to Bramann,[34] whenever there is any abnormality of descent there is more or less fixation of the testicle and a tendency to torsion of the cord. Torsion may be extra- or intra-vaginal. In the first, which is the much rarer type, the testicle and cord twist together with the sac containing them. Mauclaire and Vigneron [25] have recently reported a case of this type. In the intra-vaginal type, owing to some unusual condition of the vaginal, the testicle floats freely in it and may twist within the sac. A voluminous condition of the tunica vaginalis joined to some congenital abnormality in the attachment of the testis to the cord is considered by Rigby and Howard [3] as a predisposing cause. There may be an abnormal attachment of the common mesentery and vessels to the lower pole of the body of the testis and globus minor, so that the testicle is attached by a narrow stalk instead of by a broad band; or the globus minor may be elongated; or there may be as stated a voluminous condition of the tunica vaginalis.

Both Scudder [35] and Bramann [34] found that in torsion with undescended testis the mesorchium was abnormally long. Farr,[36] from an investigation of the literature found: that there usually was a free-lying testis with abnormally long mesorchium; that the relative size and position of the testis

and epididymis may vary greatly and that both may be malformed or misshaped; that the tunica vaginalis was unusually capacious; or finally that the cord was abnormal in length or otherwise. As regards the last Lauenstein [37] laid stress on a broad and flat cord with a long mesorchium and resulting floating testicle, and Kocher [38] thought that bifurcation of the cord favored torsion. Borchgrevinck [18] in two cases found inversion of the testis.

O'Conor [4] mentions that several authors have drawn attention to the fact that there is likely to be a venous hypertrophy, owing to increased blood supply to the testis at the time of puberty, and that such is a factor in the many cases of torsion of the cord at this early period.

Perhaps the most important contribution to the etiology of torsion of the spermatic cord is that of Uffreduzzi.[39] This author found that a normally attached testis could not undergo torsion, but that torsion was always the result of contraction of cremasteric muscle fibres. To effect this there must be an abnormal attachment of the testis associated with a capacious tunica vaginalis. Rotation of the testicle and cord can then be effected by anomalous contractions of the cremasteric muscle.

The immediately exciting cause of torsion where any of the foregoing conditions exist may be a strain, violent exercise, coughing, unusual movements, defecation, etc., in which the cremaster muscle is involved. Trauma has been reported as causative of torsion in several cases, but this can only be regarded as an exciting cause when any of the foregoing predisposing conditions exist.

The twist in the cord is generally confined to the free portion covered by the tunica and suspending the epididymis and testicle. The amount of torsion may vary from half a turn (180°) or less to two or more complete turns.

In my first case the cord was twisted five half turns. It was the same in Murray's,[9] Papin's,[8] and in one of Clute's cases.[6] In three of Keyes' [5] cases, in Weitz's case, and in Brady's [30] two cases, the twist was 360° or more, and in Butler's [21] two complete turns.

In all these cases the testicle was gangrenous and was removed.

Symptoms.—In acute torsions the onset of clinical symptoms is almost always sudden. There is sharp, stinging pain in the lower groin of affected side which generally varies in degree with the amount of torsion. The site of the lower cord is usually exquisitely tender on pressure. If the testicle is undescended there will be swelling in the groin above Poupart's ligament; the testis will be absent from the scrotum; the tumefaction has no impulse on coughing. Cases have been reported without pain or tenderness.

With descended testes the scrotal contents begin to swell immediately after torsion of the cord, the cord itself being involved in the swelling as far as the torsion. The scrotum becomes diffusely reddened and tense and the contents have the feel of being dragged upward from their normal site owing to the shortening produced by the torsion. In this stage the condition may simulate

epididymitis or orchitis from which it must be differentiated. Vomiting and nausea are very frequently accompanied by constipation, although suppression of flatus is rare. The torsion of nerves of the cord may set up reflex intestinal symptoms to which the patient may respond by drawn-up thighs and facies abdominalis. Temperature and leucocyte count are usually not much increased. In my first case the leucocyte count was 12,000.

Differential Diagnosis.—With undescended testicle the clinical symptoms are almost identical with those of strangulated inguinal hernia and in only a few such cases has a correct pre-operative diagnosis been made. The case of spermatic cord torsion which I reported in 1919 was diagnosed as strangulated hernia and I gave a tabulated list of 24 similar cases from the literature. In a few of the very recently reported cases which I have mentioned, the condition was diagnosed pre-operatively as strangulated hernia.

Rigby and Howard point out that the general symptoms of torsion are not so severe as those of strangulated hernia; vomiting is not so persistent and is never fecal; the bowels react to purgatives; there is rarely absence of flatus; and there is not the same degree of shock. Moreover strangulated hernia is unusual in youth.

Although some writers have pointed out that the absence of the important symptoms of strangulation and the fact that the testicle is absent from the scrotum (in ectopic cases) or high in the scrotum, should make diagnosis easy, yet the facility of distinguishing clinically between the two conditions is more apparent than real, as the large number of diagnostic errors recorded in literature will testify. It is not easy to rapidly rule out vomiting, obstipation and distended abdomen. Besides, as Vanvaerts remarks,[2] if an epiploic strangulated hernia co-exists with an ectopic testicle, differentiation from a torsion of the cord is impossible.

Of course, if redness and tenseness of the scrotum, high position of the testis and limitation of swelling to the lower inguinal tract can be clearly made out, and intestinal symptoms are not specially marked, the diagnosis of torsion is almost certain. But in many of these cases the symptoms of strangulated hernia seem so clear that torsion of the spermatic cord is not thought of. Of course this latter condition should be thought of and ruled out before a diagnosis of strangulated hernia is made.

Correct diagnosis is, however, of little clinical importance, as the patient usually requires immediate operative interference. In my first case which was urgent and in which the diagnosis on entering hospital was strangulated hernia, I was able by a careful examination to change this diagnosis pre-operatively to torsion of spermatic cord.

Evolution.—With regard to the evolution of these cases, Putzu [40] made a number of experimental torsions of the spermatic cord in dogs and found that a double twist effectively cuts off the circulation from the testicle and that the organ atrophied. In a few cases it necrosed and sloughed. Simpler torsions had results varying according to the amount of the twist and the length of cord twisted. Atrophy may result, but the phenomena may only be

transitory. If operated within thirty hours of complete torsion, a testicle could generally be saved.

Recent similar experiments on dogs by Keyes [5] and associates show that after one or more turns of the cord, gangrene occurs in the testicle within forty-eight hours.

The clinical results and the operative findings generally agree with the foregoing experimental evolutive effects. While in slight torsions (especially of recurrent type) spontaneous detorsion may, and in rare cases does, occur; the condition, if left untreated, may lead to atrophy and gangrene of the testicle. Atrophy is the more usual result, gangrene with sloughing being rare. There is no reason to fear a fatal result.

Treatment.—Where the testis is fully descended and the torsion is very recent detorsion should be attempted, and may prove efficacious if it can be executed by external manipulations. The torsion is, however, likely to recur, and operation will ultimately have to be done to obtain permanent relief. Meantime partial or complete atrophy of the testicle may occur.

After operative detorsion, if the testicle can be saved, an orchidopexy should be done to prevent recurrence.

Orchidectomy and epididymectomy is indicated in every case in which necrosis, gangrene, atrophy, or persistent circulatory disturbance is present. Even though atrophy might perhaps reasonably be expected, where it has not already occurred, yet the dangers which might arise from possible infection suggest removal of the testicle and tunica vaginalis with shutting off of the peritoneal cavity. When the testis is undescended, if transposition into the scrotum cannot be properly effected, the same rule should apply.

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TRAUMATIC ANEURISM TREATED BY EXCISION AND END-TO-END ARTERIAL SUTURE

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Permanent injury follows the ligation of the main artery of a limb. A reduction in the functional capacity of the part occurs even though gangrene does not follow. The circumference of the forearm or leg on the side of the ligation is reduced one-half to one inch, there is a loss of systolic blood-pressure of from 10–20 mg. of Hg. in the artery distal to the ligation, and

Fig. 1.—Aneurism of radial artery following incised wound of the wrist.

changes in the consistency and activity of muscles and in the mobility of joints are common.* This is sufficient argument against the unnecessary ligation of the more important arteries and for the substitution of arteriorrhaphy, whenever it is feasible.

I herewith report nine cases, including seven aneurisms, in which arterial suture was used. Two small aneurisms, one of the radial, the other of the brachial artery seen in civil practice, were treated by an enfolding or lateral suture. The five remaining cases were due to gunshot injuries and were treated by excision and end-to-end suture.

In about 10,000 soldiers admitted for wounds of war to United States General Hospital No. 6, Fort McPherson, Ga., there were found seven cases of traumatic aneurism. In this hospital aneurism accompanied about one per cent. of the injuries of peripheral nerves. One aneurism involving the second portion of the axillary artery, with walls formed largely by the adjacent

* Makins: On Gunshot Injuries to the Blood-vessels, Bristol, 1919.

cords of the brachial plexus, was not recognized until a violent hemorrhage followed the separation of the damaged nerve trunks. The opening was plugged by the finger, the artery sufficiently isolated above and below the false aneurism to permit of ligation and the operation on the brachial plexus completed. In this case, the condition of the patient did not warrant the prolongation of the operation by a difficult arterial suture. The patient (Case II) had no ill effect from the ligation, and recovered. A second patient with an apparent aneurism of the femoral artery did not accept operation.

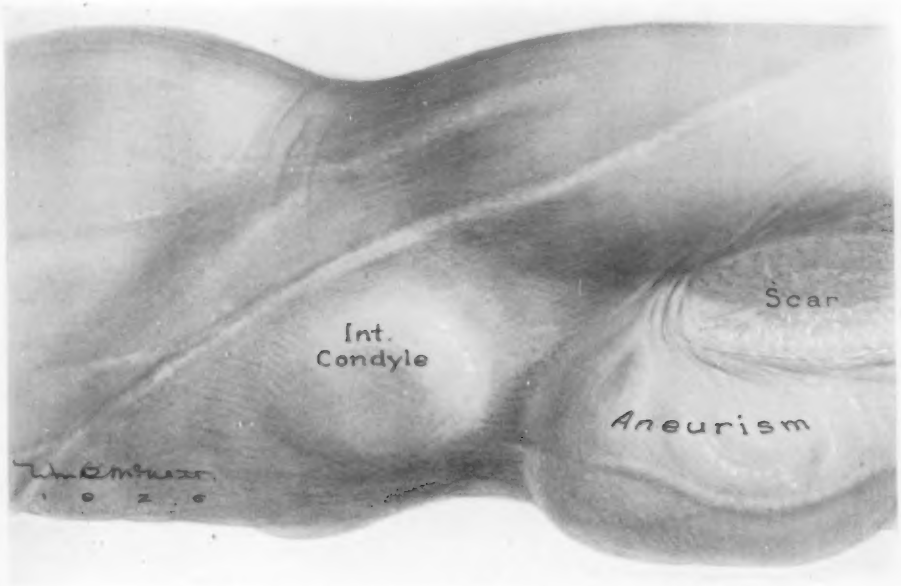


FIG. 2.—Aneurism of brachial artery following gunshot injury. Case III.

For the remaining five aneurisms, one of the axillary artery, three of the brachial and one of the radial artery, the part of the artery involved was freed, excised and the arterial ends accurately united by an end-to-end suture with fine silk. Owing to the length of the gap left in the arteries after the resection, some difficulty was experienced in the suture, and several times after two or three sutures were introduced, the elastic tension would tear off arterial rings. To reduce the tension and to permit apposition of the divided ends of the vessel, flexion of adjacent joints and traction upon the arterial clamps or upon ligatures or delicate hæmostats affixed to branches of the artery were found useful. (Fig. 6.) Or, the artery was carefully freed above and below the injury, the adjacent small branches tied with fine silk or catgut, and then by rotating a light hæmostat that had in its grasp ends of a ligature both from a proximal and a distal branch of the artery, the ligatures were wound upon the jaws in such a way as to maintain approximation. (Fig. 7.) Three interrupted guide sutures were then introduced, followed by a continuous circular suture introduced after the plan of Carrel. (Fig. 8.) After the

completion of the circular suture and on releasing the tension, in no case did the sutured ends pull apart. In several cases the union was reinforced by a cuff of fascia either wrapped circularly or spirally over the line of union and tacked in place by a few very fine interrupted silk sutures. (Figs. 9–10.) The artery after suture was buried in a vascular, intermuscular plane and the wound closed without drainage. To stretch the shortened artery it was found safe to progressively extend the flexed limb two degrees on a measured arc daily. Thus, 90° flexion could be overcome in 45 days, beginning one week

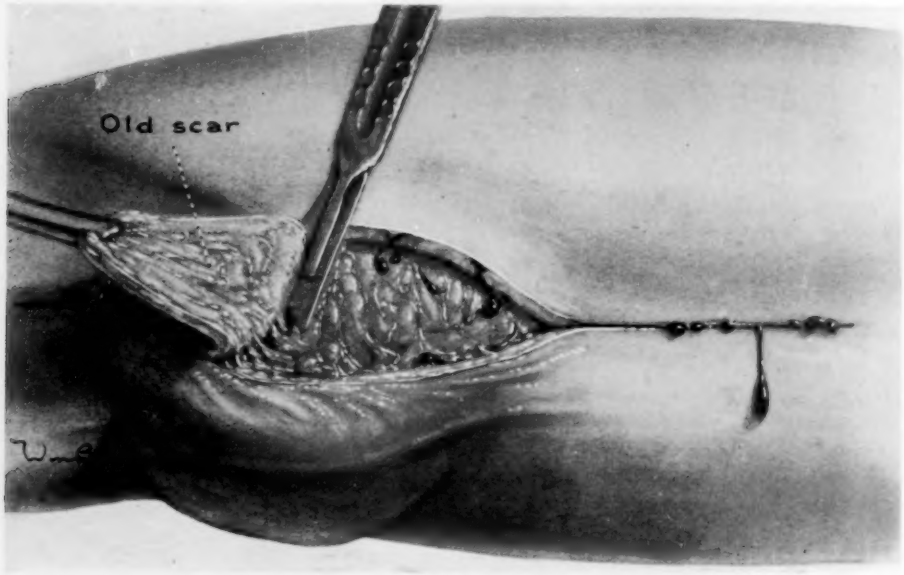


FIG. 3.—Aneurism of brachial artery. Excision of old scar. Case III.

after operation. No secondary symptoms followed these operations and in no case was there any evidence of reformation of the aneurism or of weakness of the arterial wall at the site of suture. In Case I there was a delay of several weeks before the radial pulse returned, probably from thrombosis.

In two additional cases, an arterial suture was used for the accidental injury of the femoral artery during operation. In one the femoral artery was accidentally incised in dissecting out a densely adherent sinus tract from a chronic purulent osteomyelitis of the femur, after sterilization by chloride of zinc. In this case, a lateral suture was used and the artery imbedded in muscle without suppuration or secondary ill effect. In the second case, the posterior thigh was largely disorganized and cicatricial; the femoral artery was imbedded and displaced in an enormous scar and there was a 12 cm. gap in the sciatic nerve. During the dissection, the femoral artery was incised, but could not be sutured in the cartilaginous-like scar that enveloped it. The artery was therefore resected from the dense scar and an end-to-end arteriorrhaphy performed, followed by suture of the sciatic nerve. The patient who was in bad physical condition from multiple gunshot wounds died of pulmo-

nary embolism the second day after the operation. The circulation in the leg was maintained until the time of death.

In the following cases I am indebted to Major Irving J. Spear and Captain John O. Bower for the neurologic examinations.

Case I.—*Aneurism, Traumatic, Axillary Artery, Excision and End-to-End Suture.* Howell, Clarence L., white, age twenty-seven, private, Co. K, 125th Inf. On July 31, 1918, at Chateau-Thierry, a machine-gun bullet entered the left anterior axillary fold and emerged posteriorly near the insertion of the latissimus dorsii. There was immediate

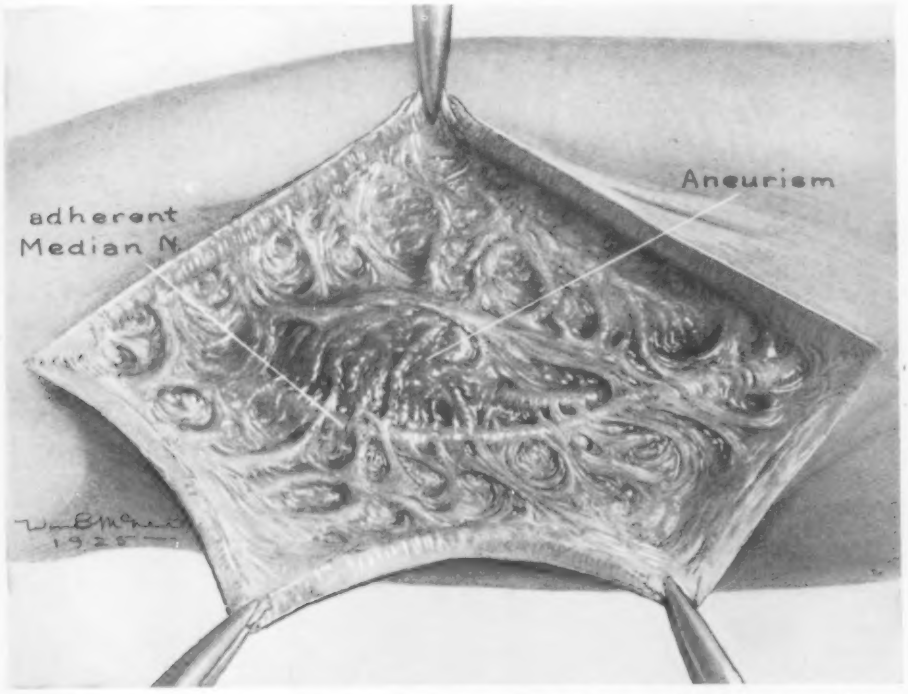


Fig. 4.—Aneurism of brachial artery. Exposure of sac and adherent median nerve. Case III.

paralysis of the left upper extremity. Power of abduction and external rotation of the arm returned in six hours, and at the end of two months he could flex the forearm on the arm. Wrist drop and inability to flex the index finger and thumb persisted. On admission, October 7, 1918, there was moderate atrophy of the entire left upper extremity with the skin thin and glossy on the palm and fibrosis of the elbow and interphalangeal joints. There was complete paralysis of the muscles supplied by the posterior cord and partial of those supplied by the inner cord of the brachial plexus with sensory loss on the external surface of the arm and forearm, and moderate causalgia in the median distribution in the palm. There was complete reaction of degeneration in the muscles supplied by the musculo-spiral and musculo-cutaneous nerves. There was a moderate œdema of the wrist. Operation under gas-oxygen-ether, October 15, 1918.

Diagnosis of Operation.—Paralysis of posterior cord of brachial plexus. Aneurism measuring 3 x 4 cm. false, traumatic, following gunshot wound, third portion of axillary artery with walls formed from the lacerated vessel wall, partially organized blood clot, adjacent cords of brachial plexus and other soft tissues, the nerve cords not divided, but adherent and traumatized.

Operation.—Resection of 4 cm. of the axillary artery including the aneurism with end-to-end anastomosis by fine black silk, the union being reënforced by a free cuff of aponeurosis. The nerve cords were freed of adhesions and isolated by strips of subcutaneous fat. The old axillary scar was excised and the wound closed by silkworm gut and continuous fine black silk without drainage. The skin sutures were removed on the seventh day after the operation and there was primary union. On November 27, 1918, about six weeks following the operation, no radial pulse was perceptible. On January 25, 1919, about fourteen weeks after the operation, there was a faint pulsation in the radial artery. April 28, 1919, voluntary contraction was present in all muscles supplied by the

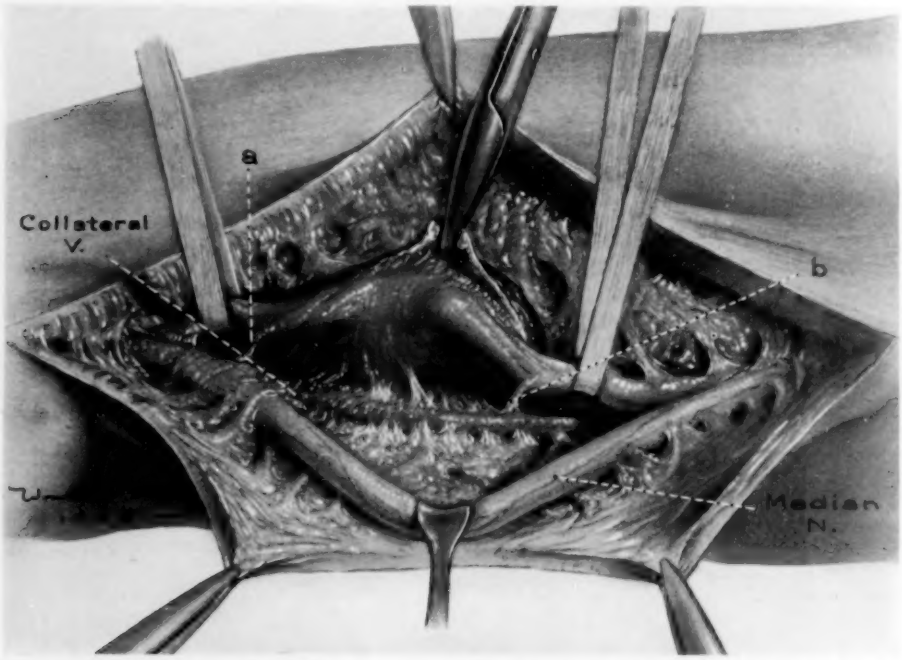


FIG. 5.—Liberation of aneurism and brachial artery. Tapes for temporary hæmostasis in place. a and b, Arterial branches requiring ligation and division.

median nerve. On August 9, 1919, the power of contraction had returned to all muscles supplied by the musculo-spiral nerve, although weak in extensor minimi digiti, extensor longus pollicis and indicis. Sensation was also improved. Discharged with C.D.D., October 11, 1919.

CASE II.—*Aneurism, False, Traumatic. Second Portion Axillary Artery. Double Ligation.* Kernie, William J., white, age twenty-two, private, Co. K, 18th Inf. On July 18, 1918, while in action at Chateau-Thierry, a machine-gun bullet entered below the middle third of the right clavicle, perforated the axilla and emerged about the middle of the external border of the scapula. This was followed by complete paralysis of the entire right upper extremity, except the power of internal and external rotation. Causalgia lasting two weeks followed and was referred to the extensor surface of the arm and forearm. The soft parts healed in 21 days. In September, 1918, the power of abduction of the arm returned, followed by that of flexion at the elbow, and then by flexion of the phalanges. On admission, September 27, 1918, there was complete paralysis and atrophy of triceps and loss of supination of forearm and extension of wrist, fingers and thumb, with complete reaction of degeneration in the muscles supplied by musculospiral nerve. There was also a moderate contraction of biceps. The aneurism was not

diagnosed prior to the operation. The patient had had slight daily afternoon temperature from September 30, 1918.

Diagnosis.—Injury to posterior cord of brachial plexus below the origin of circumflex. Latent wound infection.

Operation, October 8, 1918.—An incision was made from 5 cm. above clavicle to the anterior axillary fold, the clavicle and pectoral muscles being divided on account of operative difficulties. The brachial plexus was found imbedded in a dense adherent mass without external evidence of aneurism. In the separation of the cords of the brachial plexus the aneurism was entered. The opening was immediately plugged by the finger,

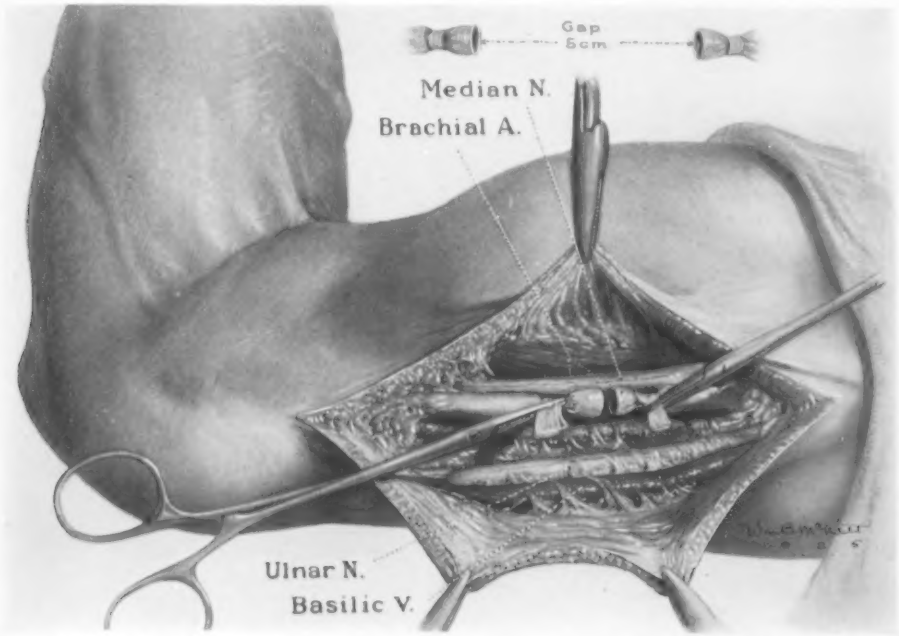


FIG. 6.—Illustrating one method used in overcoming the arterial gap left after excision of the aneurism. The artery is liberated well above and below the lines of section, the elbow-joint acutely flexed and the arterial ends apposed during the suture by pressure upon the two hæmostats that grasp the sections of soft tape used to occlude the vessel.

and with difficulty, the axillary artery exposed above and below the sac and doubly ligated. It was also necessary to temporarily occlude the axillary vein to control the hemorrhage. The patient was in too serious a condition to permit an arterial suture. The nerve trunks were freed with a limited hersage, the divided muscles united with catgut, the clavicle with silver wire and the wound closed without drainage.

Diagnosis at Operation.—Aneurism, false, traumatic size of English walnut, second portion of axillary artery, right; cavity lined with clot, walls formed by adjacent adherent nerves and other tissues, old perforating wound involving posterior cord of the brachial plexus. After the operation, as a result of the latent wound infection, drainage occurred and continued until January 20, 1919. On February 1, 1919, the patient showed distinct improvement in nerve conduction and could dorsiflex the hand at the wrist. In March, 1919, sensation had returned but there was atrophy and weakness of the extensors of the wrist and paralysis of the extensors of the fingers. The reaction of degeneration of the muscles supplied by the musculo-spiral nerves persisted. No evident trophic loss had followed the ligation. Patient was discharged on a C.D.D., May, 1919, with a diagnosis of partial interruption of posterior cord of brachial plexus below the circumflex nerve with no sensory disturbance.

CASE III.—*Aneurism of Brachial Artery—Excision of 5 Centimetres of Artery and End-to-End Suture.* Philip, J., corporal, Co. L, 28th Inf. Admitted May 6, 1919, having sustained gunshot wounds of right and left arm on the Argonne front, October 1, 1918.

Examination shows a fairly firm, oval mass the size of a plum, with a slight expansile pulsation in the line of the brachial artery just above the right elbow. The X-ray examination is negative. (Fig. 2.)

Operation.—May 12, 1919, under brachial plexus and local anæsthesia with procain. Incision showed a saccular aneurism measuring 3 x 4 x 5 centimetres of the external wall

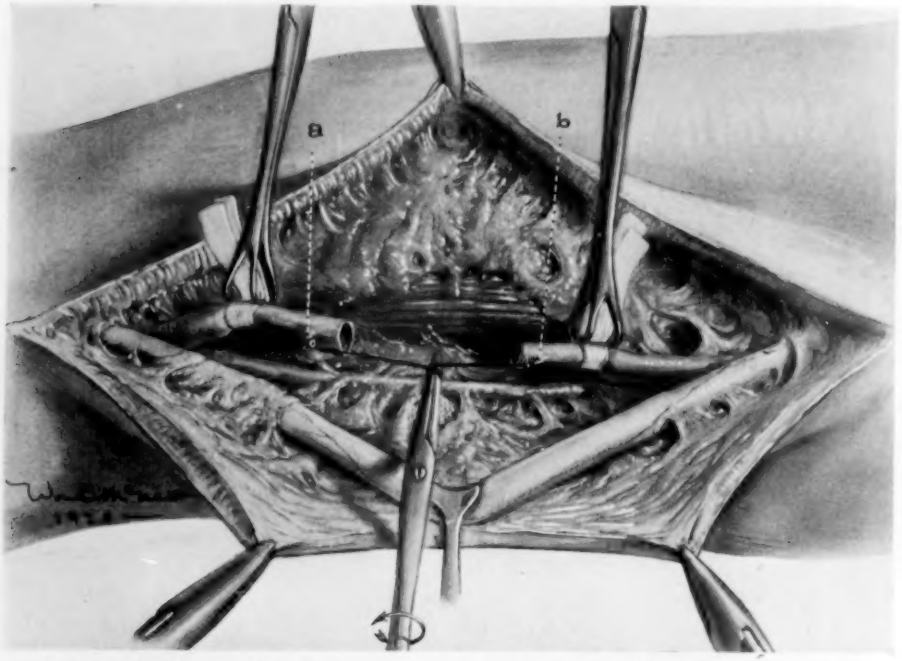


FIG. 7.—Aneurism excised. Illustrating a second method of making traction and maintaining apposition of the divided ends of the artery during suture by rotation of a hæmostat that grasps ligatures affixed to one small arterial branch on the proximal and one on the distal portion of the artery. (a and b.)

of the brachial artery. The median nerve was adherent, but not divided. The portion of the brachial artery containing the aneurism was excised, leaving a gap in the artery of 5 centimetres. By flexing the elbow and by making traction on the artery, the gap was overcome and an end-to-end arteriorrhaphy produced with guide and continuous suture of fine arterial silk. The line of suture was wrapped with a free transplant of fat and fascia tacked in place with fine silk. The muscles and fascia were united over the artery by chromic No. 1 catgut and the skin with interrupted silkworm gut and continuous fine black silk. There was primary union with a good radial pulse and some thickening at site of arterial suture. The flexed arm was treated by graded extension and the patient transferred for discharge, June 10, 1919.

CASE IV.—*Saccular Aneurism, Brachial Artery with Excision and End-to-End Suture.*—Morrison, Clyde, private, Co. K, 59th Inf. While in action at Chateau-Thierry, July 20, 1918, a machine-gun bullet passed through lower third of the right arm. It entered 5 cm. above the outer condyle to outer side of biceps and emerged on inner aspect of the arm between the brachialis anticus and triceps. After an operation performed immediately following the injury, the patient noted a complete loss of power

below the wrist, except in the little finger. Six days later, a second operation was done for infection. The hand continued swollen for three months, the skin became dry and hard and the nails curved. The wound healed in one month, but a numbness on the palmar surface of hand continued and causalgia persisted for two months. After the second operation, a pulsation at the site of operation was felt by the patient. The radial pulse which had been absent on the affected side returned suddenly six weeks after the injury. The diagnosis on admission was aneurism, right brachial artery, traumatic, with injury of the right median nerve. A tumor is present on the mesial side of the right arm just above the elbow. It is expansile, pulsating and gives a bruit.

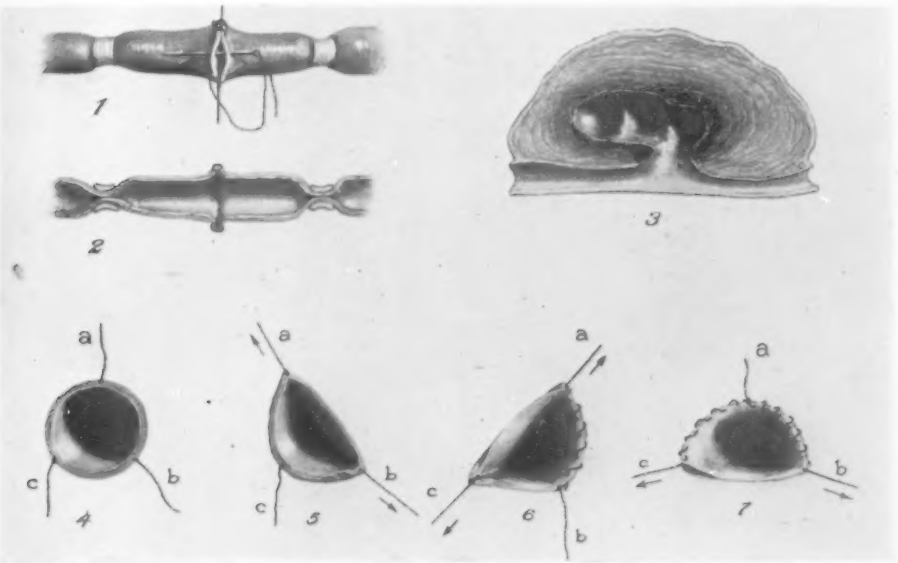


FIG. 8.—Nos. 1 and 2. Arterial suture with aversion of intima using guide and continuous sutures of fine silk. No. 3. Section of saccular aneurism of brachial artery lined by laminated clot. Case IV. Nos. 4, 5, 6 and 7. Guide and continuous sutures.

There is a loss of pain and tactile sensation in the internal cutaneous distribution of the right forearm and of the median distribution to the fingers and palm; and also loss of motion in fingers with imperfect extension and atrophy and reaction of degeneration of small muscles of right hand supplied by the median nerve. The hand is cyanosed with no œdema, otherwise the patient's condition is normal. On February 27th, the X-ray findings were negative. Operation, March 8, 1919.

Diagnosis at Operation.—(1) Scar 2 x 5 centimetres extending upward from point two centimetres above internal condyle, right, humerus. (2) Internal saccular aneurism, right brachial artery measuring 4.5 by 3.8 by 2.5 centimetres, extending from elbow upward. The artery had a small oval lateral opening leading into a small aneurismal cavity lined on mesial side by laminated clot. (Fig. 8, No. 3.) (3) Partial paralysis of median nerve. Median nerve flattened and adherent over mesial surface of aneurism.

Operation.—Twenty centimetres vertical incision with excision of old scar. Aneurism excised, leaving gap of three centimetres in artery. Arteriorrhaphy by end-to-end suture with very fine silk in petrolatum. Line of union wrapped with a free strip of fibro-connective tissue taken from wound. Neurolysis of median nerve without division of sheath. Deep closure with No. 0 chromic gut. Skin closure with silkworm gut and continuous silk. The recovery was uneventful and on examination July 3, 1919, there was a normal radial pulse and power of voluntary contraction in all muscles below the seat of injury. Discharged to Mobilization Camp, July 5, 1919.

CASE V.—*Aneurism Brachial Artery, Excision of Four Centimetres of Artery, End-to-End Suture.* Black, Wm. H. B., white, age twenty-four years, private, Infantry. Previous and personal history negative. On July 18, 1918, while in action near Soissons, this soldier received a machine-gun bullet wound which penetrated his left arm in the middle third, without fracture and without secondary infection. He was admitted to the hospital, October 23, 1918, with the diagnosis of aneurism of left brachial artery previously made. Examination showed scars from a perforating gunshot wound on the internal and external surface of the middle third of the left arm. A small aneurism of the brachial artery about the size of an olive, expansile and pulsating was present about

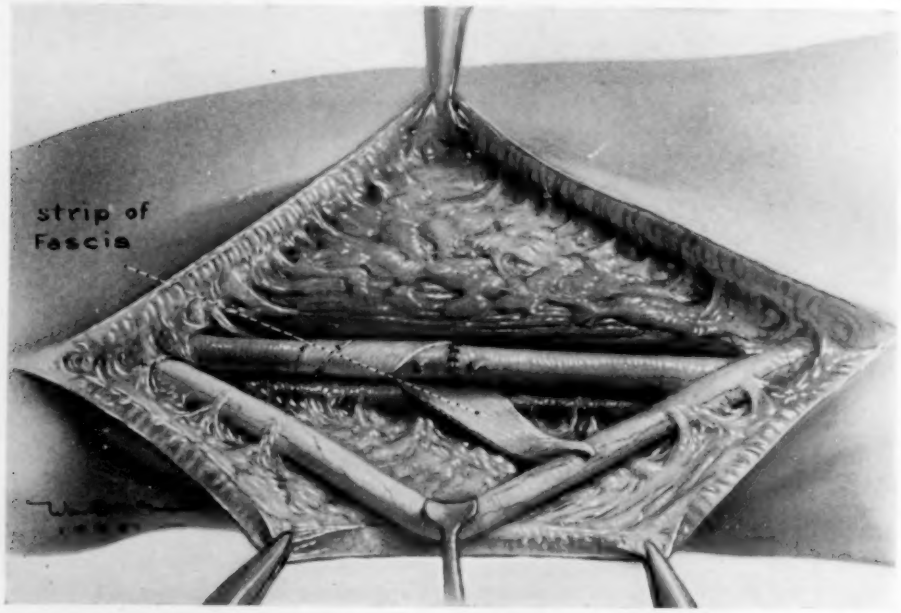


FIG. 9.—Arterial end-to-end suture complete. The line of union is being reënforced by a spiral wrapping with a strip of aponeurosis obtained from the depths of the wound. The aponeurotic wrapping is tacked in place by a few interrupted sutures of very fine silk.

10 centimetres above the internal condyle. The patient was well-nourished and in good general condition. Operation, October 25, 1918. Anæsthetic, local with procain.

Diagnosis at Operation.—Aneurism, saccular, brachial artery middle third, from subcutaneous inner portion of wall, size of marble, partially lined with laminated clot. Operation consisted in excision of aneurism, including four centimetres of artery and end-to-end arterial anastomosis with fine silk. The arterial junction was reënforced by a free cuff of aponeurosis. Deep suture was with chromic 0 catgut, the skin with silkworm gut and fine black silk. The skin sutures were removed on the fifth day following operation and there was primary union. On examination, November 19, 1918, the radial pulse was strongly perceptible at the wrist. There was some limitation of motion at the elbow. On December 17, 1918, the patient was transferred to a convalescent camp for discharge in good condition.

CASE VI.—*Aneurism Right Radial Artery—Excision and Suture.* Sparks, Emerson, white, private, Infantry, age twenty years, admitted October 23, 1918. Register No. 11,448, born in Alabama, occupation, farmer. On July 26, 1918, while in action, the patient was struck by a shell fragment which entered the anterior lateral surface of the middle third of right forearm and made its exit on the anterior surface just above the lower end of the ulna. The patient entered this hospital with diagnosis of gunshot

wound on right forearm (healed). He now complains of a tumor at the wound of entrance and of numbness in the little and of the inner half of the ring finger. Examination shows a firm subcutaneous tumor, not movable under the wound of entrance in the situation of the radial artery. The tumor is about the size of a marble, it does not pulsate, and is barely palpable. There is a loss of pain sensation on the palmar surface of the little and mesial half of the ring finger. There is a definite atrophy of the interosseous muscle in the fourth space. On October 31, 1918, the usual pre-operative

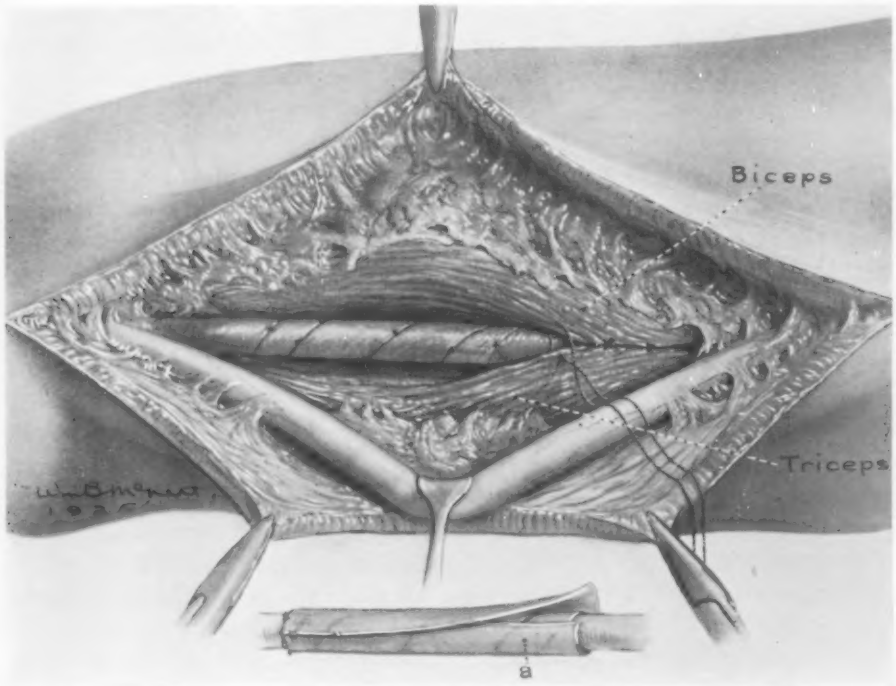


FIG. 10.—Reënforcement of arterial suture by a spiral wrapping of aponeurosis completed. Artery being buried in the intermuscular plane between the biceps and triceps. At a, is shown a second method of arterial reënforcement used. The transplant of aponeurosis is wrapped like a cuff about the line of union.

treatment was given. Anæsthetic, local procain, one per cent., 60 c.c. with inhalation ether 140 c.c.

Diagnosis at Operation.—Aneurism false, radial artery right forearm, one-half centimetre in diameter, five centimetres above wrist, filled with thrombi, adhesions of ulnar nerve three centimetres above wrist.

Operation.—Excision of aneurism, end-to-end anastomosis of artery, with fine silk. Separation of adhesions of ulnar nerve. Excision of old scar tissue. The post-operative recovery was uneventful. At examination on November 15, 1918, the radial pulse was found strongly perceptible at the wrist. Circulation and sensation in the hand showed definite improvement. The patient after a furlough was transferred to convalescent centre, Camp Sheridan, Ala., on December 20, 1918, as cured.

POST-OPERATIVE COMPLICATIONS*

BASED UPON CASES AT THE LANKENAU HOSPITAL

By J. Bernhard Mencke, M.D.

of Philadelphia, Pa.

A survey of the records of operative cases of certain classes at the Lankenau Hospital gave rise to an endeavor to formulate conclusions.

First.—As to the nature of these complications, whether any might be classed as entirely unavoidable, and how others might be avoided, and

Secondly.—In what manner circumstances differed from those, of say, five years ago.

As far as older records are concerned, they can only be considered in a general way—post-operative notes were not then in use as part of the permanent records, except in so far as supplied by hourly nursing charts.

As typical of grave operations of election, there were studied 67 cases of gall-stone disease operated upon in 1924.

In a great number of these cases a diagnosis of chronic appendicitis had been made, or appendectomy performed, and chronic appendicitis diagnosed on section.

An examination of the results in these cases brings out several features:

First.—The complications which might be classified as due to the nature of the operative procedure itself, *i.e.*, those depending upon the technicalities of operative work, are about as they have always been. In gall-bladder surgery, we have to contend in this respect with hemorrhage and leakage. In practically all of our cases of calculous cholecystitis we now perform cholecystectomy. Occasionally there is of course found necessary the drainage of the common duct or the stump of the cysticus. In several of these cases bile leakage of considerable amount has taken place.

The occurrence of such leakage, and also of the occasional cases of hemorrhage has given rise to doubts as to the use of catgut to close channels and viscera, or to hold drainage tubes. At present we have nothing better at our command.

Secondly.—Phlebitis is rare as a complication compared to our series of cases of years ago. Not uncommon previously, we have seen but little of it lately.

Thirdly.—A complete change has taken place in our methods of anæsthesia. We now employ almost entirely gas-oxygen anæsthesia, occasionally using a little ether if absolutely necessary to procure enough relaxation to permit operation.

There is of course with this form of anæsthesia not the deep narcosis that we procure with ether. On the other hand, the formation of mucus is less, cyanosis is rare, and sweaty, clammy relaxation of the skin is almost unknown.

* Read before the Philadelphia Academy of Surgery, March 2, 1925.

POST-OPERATIVE COMPLICATIONS

Prior to the introduction of the use of nitrous oxide, and oxygen anæsthesia, there were several well-marked minor epidemics of post-operative pneumonia upon various services. Especially upon one occasion the number of cases of post-operative pneumonia in the men's surgical service was unusually high. No definite cause for this could be found after most painstaking investigation. This has not in any way occurred since the use of nitrous oxide and oxygen routinely.

The question might arise whether some of the technical difficulties met with are not heightened by lack of complete relaxation. We do not think that this is the case.

The only suggestion for the reduction of the incidence of bronchial and pulmonary complications is that some improvement might be noted if the pre-operative care and cleansing of the mouth were more thorough.

In the series of 67 cases operated upon for cholelithiasis only two showed distinct post-operative pulmonary complications.

Upon one or two occasions, in other operative conditions, broncho-pneumonia has developed where no inhalation anæsthesia was used.

One case of parotitis occurred in these 67 cases.

In operations of election, a certain amount of help has been given by laboratory diagnoses of renal and blood insufficiencies or abnormalities.

Our experience in this direction may be summarized in the statement that tests of kidney function of the more modern kinds are of value, but not absolute—*i.e.*, occasional marked kidney insufficiency follows operations even when the functional tests are satisfactory. Of more definite value is the estimation of the sugar content of the blood.

In this connection a survey of the causes of death in acute appendicitis in 1924, at the Lankenau Hospital, shows some facts of interest. Of 325 such cases operated upon in 1924, 16, or 5 per cent., died. Four of these cases were in diabetics, in which the blood sugar on admission varied from 170 to 330 mg. per 100 c.c. of blood. Operation of course was unavoidable, and cases such as these would be bad risks, even if we could control the blood sugar content, because the tissues are all below par, and most diabetics are, or have been, obese, with corresponding impairment of the myocardium. Of the 4 diabetics, 3 actually died in diabetic coma. Seven of the fatally ending cases had advanced nephritis. Here again we are faced with an impediment to operation which the urgency of the occasion causes us to disregard. Three of the nephritis cases actually died of uræmia. One case each died of pulmonary embolism and cardiac dilatation.

Cardiac dilatation I have also found noted as a cause of death in one of the gall-stone cases. In other records I have found the term "Toxic Myocarditis." It has seemed that these causes of death are sometimes assigned without due regard to the symptomatology. We would think that cardiac dilatation described a condition somewhat definite, and should not be applied to those cases in which direct shock caused death in from 10 to 40 hours after operation, even in the presence of signs of cardiac dysfunction.

The classification of causes of death after operative procedures is not very precise. Five of the cases dying of acute appendicitis had general peritonitis, not surprising when 12 of the 16 patients who died had a gangrenous appendix, with a pus collection in the pelvis. Doctor Bortz, who looked up these records says: "It is probable that more of the cases had this condition present, but not all the cases come to autopsy." Seven of the 16 cases were markedly obese. These patients are poor risks for any form of operative procedure, even if in every other way physical examination is negative, and the usual tests indicate no grave functional lesson.

We still consider our percentage of wound infections high. It varies markedly with identical technic in different periods of time. No method of skin preparation has been found that greatly reduces it. Where drainage is instituted some slight wound infection is the rule, but it should in some way be possible to avoid it in otherwise clean cases. The reservation may be made that no case in which an abdominal viscus is opened, even by cautery, remains an entirely clean case. The percentage of cases in which some serum was found in the wound, does, however, not differ greatly in the herniotomies, and in the cases of chronic appendicitis. Few of the so-called clean cases showed a frankly purulent infection, and for those which showed serum and breaking down various possible causes have been assigned. Among these are: Faulty hæmostasis. Too tightly drawn sutures with devitalization of intervening tissues. Excessive use of suture material. Qualities inherent in all absorbable suture materials prepared for a considerable stay within the tissues.

The three first-mentioned causes we believe ourselves to be handling correctly.

The fourth presents a serious question. There is no reason to think that the sutures carry, or have infection, but all of them are impregnated with some preparation to toughen them. Those of you who have observed the effects of chromic acid, and certain of the chromates upon the skin of men using them in the industries, will have no doubt that even a slight excess may have a harmful effect on tissues. The same may be said of iodine. The question is an open one—what is true is that in all clinics a certain number of cases of infection occur which it seems could be avoided.

The methods of operating are many in number, but operating room technic is usually good in the places we have investigated. With standard carefully executed technic, many surgeons feel that the percentage of untoward occurrences, grave or slight, is still too large.

In acute appendicitis the number of post-operative complications is still not inconsiderable. The cases on the average still come to the surgeon too late. We are sure that we have reduced our mortality greatly by not too great haste in operating upon those cases in which the infection has already spread beyond the appendix. The incidence of diffuse peritonitis after operation is also less than some years ago, in those cases not coming to a fatal termination.

Were we to summarize our conclusions upon post-operative complications, with especial reference to abdominal surgery, based upon the cases at the Lankenau Hospital, we might say:

1. In reference to cardiac conditions: That we as yet have no reliable guide as to the cardiac efficiency of a gravely ill patient, and no method of ascertaining that the heart can or will stand the strain of anæsthesia, and operation, and that a certain number of deaths are attributed to cardiac conditions in which other causes are primary.

2. In reference to pulmonary conditions: That these have been reduced almost as far as is possible with any form of inhalation anæsthesia.

3. That studies of kidney function and blood chemistry are fair guides in eliminating certain cases as good operative risks.

4. That wound infection, and failures to heal by first intention, are still too frequent, but that no definite cause for these complications can yet be given.

THE SURGICAL SERVICE AT THE HOSPITAL OF THE UNIVERSITY OF PENNSYLVANIA*

By I. S. Ravdin, M.D.

of Philadelphia, Pa.

If an apology is needed for offering this paper, I can only say that it is presented after attempting to obtain statistics from the surgical services of other institutions for comparison with those of the Surgical Division of the Hospital of the University of Pennsylvania. Anyone who attempts to compare the results of one hospital with those of another will early realize that the difficulties are many. With the idea of organizing a system which was simple and rational, we have developed a plan which, we believe, is suitable for the surgical divisions of other hospitals. The plan is presented with the hope that similar systems will be begun elsewhere, so that comparisons of morbidity, mortality and end-results can be made on an equitable basis.

We found it necessary to systematize our work as the service grew. Since September, 1922, the number of operations has increased 120.7 per cent. over the previous year. Systematization of our work was essential, and time and energy have been conserved by coördinating the statistical work of all services in one office. A uniform system, under careful check, has resulted in thorough study of cases, with complete records. We have attempted to develop a plan which will contribute the maximum return to the division. This, of course, to a certain extent means subordination of the individual, but with several services and with men holding corresponding positions in each service there has been enough competition to serve as a gentle stimulus.

The pre- and post-operative technic has been standardized as much as possible. Where surgeons have held widely divergent opinions individual preferences have not been sacrificed. However, we have found that in many particulars there has been no wide divergence of opinions and all services have been able to agree on a common technic. In the operating room the draping of patients and the sizes of sponges are uniform. This is of much help to the operating room staff.

The Surgical Record Room receives a list of the admissions to the Surgical Service every evening at five o'clock. The histories of these patients are typed on the following day. If, for any reason, the interne has not written the history, he must account for the delinquency. The notes of the operation are dictated by the surgeon or his assistant to a stenographer and are attached to the record.

Before the patient can be discharged three things must be done: The history must be completed and signed by the interne; the date for follow-up examination must be attached and the patient given a card upon which is

* Read before the Philadelphia Academy of Surgery, February 2, 1925.

TABLE I.

Week Ending December 30, 1924.

Name	Adm.	Dis.	Diagnosis	Operation	Days	Immed. Result	Inf.	Complications	Comment	Anæs.	Anæs. Comp.	End result	Disp.
						Service Y							
1 B..... H.....	12/21	12/24	Diabetic gangrene rt. foot,	Amputation leg	3	Unimp.	None	None	Blood sugar .536	Gas	None	Death	
2 R..... S.....	12/17	12/24	Acute appendicitis	Appendectomy	7	Imp.	None	None	None	Gas-e	None	Recd.	P. P.
3 G..... J.....	12/11	12/25	Hernia, inguinal, right	Ferguson hernior.	14	Imp.	None	None	None	Gas	None	Recd.	S. D.
4 L..... F.....	12/18	12/28	Disl. semilunar cart. knee, left	Excision cartilage	10	Imp.	None	None	None	Gas-e	None	Recd.	P. P.
5 J..... K.....	12/2	12/29	Burns of feet	Denudation, skin graft, transfusion	27	Imp.	None	None	Reaction from transfusion	Ether	None	Recd.	S. D.
						Service X							
1 H..... D.....	12/11	12/24	Adenoma thyroid	Excision	13	Impd.	None	None	None	Gas	None	Impd.	P. P.
2 A..... I.....	12/10	12/24	Saphenous phlebitis	Excision	14	Impd.	None	None	None	Gas	None	Impd.	P. P.
3 R..... R.....	12/22	12/25	Sebaceous cyst, right arm Papillomata face, back, mult.	Excision	3	Impd.	None	None	None	Gas	None	Impd	P. P.
4 P..... R.....	12/5	12/27	Gangrene left leg	Amputation	22	Impd.	None	None	None	Spinal	None	Impd.	P. P.
5 M..... C.....	12/25	12/27	Fracture surg. neck humerus	Dressing	2	Impd.	None	None	None	None	None	Impd.	S. D.
						Service Z							
1 R..... G.....	12/27	12/28	Carcinoma bladder	Radium application. Cystoscopic	2	Impd.	None	None	None	Caudal	None	Impd.	P. P.
2 R..... R.....	12/1	12/26	Carcinoma bladder	Suprapubic cystotomy Implantation radium	26	Impd.	None	None	Discharged with permanent s. p. fistula	Gas-e	None	Impd.	P. P.
3 S..... M.....	12/21	12/29	Varicocele	Excision	9	Impd.	None	None	None	Gas	None	Impd.	P. P.

written the date he or she is to return for follow-up examination. This was sent to the ward on the day following admission and needs only to have the date filled in. The history is turned in at the Main Office when the patient leaves the hospital. Thus, on the day following discharge we have the records of all patients who left the service on the previous day. The record is a true history of the patient and is not compiled from the memory of the interne long after the discharge of the patient.

At a set time each week the discharges of the previous week are dis-

TABLE II.

Hospital of the University of Pennsylvania Surgical Division Report for The Month of December, 1924.

Service of	Admissions			Discharges				
	Male	Female	Total	Male	Female	Rec'd.	Died	Total
1. Division W	16	22	38	22	24	45	1	46
2. Division X	36	29	65	33	21	53	1	54
3. Division Y	31	22	53	32	22	50	4	54
4. Division Z	12	0	12	12	1	13	0	13
Totals	95	73	168	99	68	161	6	167

Operations.

December, 1924.

Service of	Operations		Recovered		Died	
1. Division W	31		30		1	
Assistant A	9	41	9	40	0	1
Assistant B	1		1		0	
2. Division X	38		37		1	
Assistant	24	62	24	61	0	1
3. Division Y	38		35		3	
Assistant	16	54	16	51	0	3
4. Division Z	7		7		0	
Assistant	1	8	1	8	0	0
Totals		165		160		5

cussed at a Junior Staff Conference. The assistant surgeons, the surgical internes, the head nurse of the operating room, the chief anæsthetist, the clerk of the record room and a stenographic clerk attend. Table I illustrates the method of tabulation at this meeting.

At this meeting the diagnosis is filled in according to the record clerk's classification and the record is accepted as completed or rejected as the occasion demands. If it is rejected, the interne completes it at that time. The complications are discussed and scheduled. Any problems which have come up during the previous week are discussed and, if necessary, are carried over to the monthly meeting. Free discussion by the internes and nurses is encouraged. It is instructive and illuminating.

The Neurosurgical Service holds a separate weekly meeting under the supervision of Doctor Frazier.

Once a month the entire surgical staff meets and goes over the work of the previous month. Each member has before him a synopsis of the month's activities. Tables II, III, IV, V, VI, VII, VIII illustrate a report.

TABLE III.

Diagnosis of Cases That Died
December, 1924.

Service of	Diagnosis	Operation	Cause of death	Died within 24 hrs.	Died within 48 hrs.	Died after 48 hrs.
Division W						
1. A..... S.....	Brain tumor	Rem'l tumor	C	x		
Division X						
1. H..... W.....	Carcinoma of œsophagus	Gastrostomy. Exposure of œsophagus in neck. Transfusion	P. D.			x
Division Y						
1. R..... Z.....	Third deg. burns	None	P. D.	x		
2. A..... H.....	Liver abscess	Drainage	P. D.			x
3. B..... H.....	Diabetic gangrene	Amputation of leg	P. D.		x	
4. G..... N.....	Hypertrophic stenosis pylorus	Posterior gastro-enterostomy	P. D.		x	
Division Z	None					

TABLE IV.

Pulmonary Complications.

Service of	Diagnosis	Anæsthesia	Complications	Lived or died
Division W	None			
Division X	None			
Division Y				
1. J..... P.....	Strang. hernia	Gas-ether	L. pneumonia	Lived.
2. C..... F.....	Duodenal ulcer	Gas-ether	L. pneumonia	Lived.
3. M..... F.....	Chr. appendicitis	Gas	Bronchitis	Lived.
4. T..... L.....	Acute gang. appen.	Gas-ether	L. pneumonia	Lived.
Division Z				
1. E..... G.....	Carc. bladder	Spinal	Pleurisy	Lived.

Wound Complications

Service of	Diagnosis	Type of complications	Original condition
Division W	None		
Division X			
1. P..... D.....	Carc. stomach	C	Not infected.
Division Y			
1. C..... F.....	Duodenal ulcer	A	Not infected.
Division Z	None		

In reporting the deaths, the surgeon presents a written report of the case and each member of the staff expresses his opinion as to the cause of death. The discussion is free and unhampered and the staff has found it very useful.

TABLE V.

Other Complications.

Service of	Diagnosis	Complications	Lived or died
Division W 1. A..... O.....	Tic. dol.	Facial paralysis	Lived.
Division X.....	None		
Division Y F..... R.....	Chr. cal. cholecystitis	Ischio-rectal abscess	Lived.
Division Z E..... G.....	Carcinoma bladder	Phlebitis	Lived.

Renal Complications

None

TABLE VI.

Report of Surgical Pathology.

December, 1923.....	80
1924.....	64

Autopsies

Service of	Deaths	Autopsies	Per cent.
1. Division W.....	1	1	100
2. Division X.....	1	1	100
3. Division Y.....	4	2	50
4. Division Z.....	0	0	00
	6	4	66.6

Follow-up

	Total to report	Returned	Per cent.
Division W.....	67	23	34.3
Division X.....	144	58	40.3
Division Y.....	78	28	35.8
Division Z.....	8	6	75.

It is here that the cause of death is rated according to the table which I shall show later. The probable causes of the various complications are discussed. The discussion frequently brings out peculiarities of an operator and cannot but be helpful. Destructive criticism is a rarity, while constructive criticism is the rule.

The analysis of morbidity and mortality again stresses the importance of

TABLE VII.

Ether Report of General Surgical Clinic for Month of December, 1924.

Patients 131	*Frazier Clinic. Operations 41*
24 ether	12 ether
43 gas	8 gas
34 gas-ether	15 local
17 local	5 local and ether
5 gas-local	1 chloroform
3 spinal	
1 sacral	41
5 none	
131	

41 private patients

95 ether cans received
65 ether cans used

Nitrous oxide 16
Oxygen 18

Cases Treated in Surgical Dispensary

New cases....	229	Referred to house....	7
Old cases.....	1037	Total.....	1266

Urological Dispensary—December, 1924

New cases....	91	Referred to house....	3
Old cases.....	570	Total.....	661

TABLE VIII.

Comparative Statistics. December, 1924.

General mortality	Cases	Deaths	Per cent.
December, 1923.....	152	18	11.8
December, 1924.....	167	6	3.5
Operative mortality			
December, 1923.....	182	16	8.8
December, 1924.....	165	4	2.4

Wound Complications

	Operations	Complications	%	A	%	B	%	C	%
December, 1923....	182	5	2.6	0	0	4	80	1	20
December, 1924....	165	2	1.2	1	50	0	00	1	50

Pulmonary Complications

	Operations	Complications	%	Lived	%	Died	%
December, 1923.....	182	3	1.6	2	66.6	1	33.3
December, 1924.....	165	5	3.03	5	100.	0	00.

a thorough history and physical examination, and a careful consideration of each patient before operation. Yet we make no claim of perfection for from our results you will see that many mistakes are made in spite of care and effort.

From the monthly reports a semi-annual and, later, an annual report are compiled.

When one attempts to discuss mortality and to compare these figures with those of other hospitals, he is confronted with the fact that in one hospital

TABLE IX.

Year Ending September 1, 1923.

Operations		Deaths	Per cent. general mortality
September, 1922	110	5	4.5
October, 1922	160	8	5.0
November, 1922	147	12	8.1
December, 1922	127	8	6.3
January, 1923	149	8	5.3
February, 1923	172	9	5.8
March, 1923	177	18	10.1
April, 1923	183	14	7.6
May, 1923	181	10	5.5
June, 1923	162	12	7.4
July, 1923	141	5	3.5
August, 1923	155	12	7.7
Totals	1864	121	6.5 Operative mortality. Combined services.

the surgeon, with all the facts known to him, concludes that a death should or should not be attributed to the operation; in another institution all deaths occurring two, three or four weeks after operation are counted as surgical deaths; while in others, patients with medical complications, such as pulmonary and kidney lesions, are transferred to the medical division, and, if death occurs, these are classified as medical deaths.

At the Hospital of the University of Pennsylvania all medical complications are treated on the surgical division. A medical consultant is on duty at all times. He makes daily rounds of the surgical wards and sees patients before and after operation as requested. All deaths are therefore charged to the operation without regard to the length of time elapsing between operation and death. This method, on the whole, works no gross injustice and it eliminates individual estimation in classification.

From September, 1922, to August, 1923, inclusive, there were 1864 operations on the surgical division with 121 deaths, or an operative mortality of 6.5 per cent. Because of the added operative risk in neurosurgical operations, the mortality is divided. The mortality on the general surgical service was 5 per cent., while that on the neurosurgical service was 11.9 per cent. From September, 1923, to August, 1924, inclusive, there were 2474 operations with 141 deaths, an operative mortality of 5.6 per cent. The mortality of the general surgical service was 4.5 per cent., while that of the neuro-

surgical service was 11.6 per cent. From September, 1924, to December, 1924, inclusive, there were 760 operations with 24 deaths, an operative mortality of 3.1 per cent. The type of case admitted to the surgical

TABLE X.

Comparative Statistics, General Operative Mortality.

	Operations	Deaths	Per cent.
General surgical service	1471	74	5.0
Neuro-surgical service	393	47	11.9

Comparative Statistics, General Surgical Clinic.

1921–1922
1922–1923

Sept. 1922—Sept. 1923		Sept. 1921—Sept. 1922	
September, 1922	96 cases	September, 1921	71 cases
October, 1922	105 cases	October, 1921	84 cases
November, 1922	103 cases	November, 1921	99 cases
December, 1922	100 cases	December, 1921	86 cases
January, 1923	113 cases	January, 1922	81 cases
February, 1923	134 cases	February, 1922	81 cases
March, 1923	134 cases	March, 1922	114 cases
April, 1923	153 cases	April, 1922	100 cases
May, 1923	141 cases	May, 1922	92 cases
June, 1923	124 cases	June, 1922	65 cases
July, 1923	124 cases	July, 1922	49 cases
August, 1923	139 cases	August, 1922	72 cases
	1471 cases		994 cases

Per cent. increase, 1923—32.4 per cent.

TABLE XI.

Operative Mortality.
September, 1923—August, 1924, inclusive.

	Operations	Deaths	Per cent. of operative mortality	
September, 1923	165	4	2.4	This mortality includes the General Surgical Service, the Urological and the Neuro-surgical Services.
October, 1923	201	13	6.5	
November, 1923	182	16	8.8	
December, 1923	182	16	8.8	
January, 1924	228	10	4.4	
February, 1924	222	10	4.5	
March, 1924	233	21	9.0	
April, 1924	261	9	3.4	
May, 1924	279	16	5.7	
June, 1924	188	9	4.7	
July, 1924	189	9	4.7	
August, 1924	144	8	5.5	
Total	2474	141	Average 5.6	

division is essentially the same throughout the year. The hospital has a large emergency service which adds to the operative mortality. The reduction in the number of deaths we believe can be attributed, in part,

to the following factors: More careful preparation of the patient before operation, greater attention to detail in the post-operative care, and the constructive criticism developed during the discussion of the monthly report at the staff meeting. The *esprit de corps* in the surgical wards between the nurses and the surgical staff is another factor.

A careful study of mortality statistics from year to year yields valuable suggestions. Many of the deaths occur from so-called accidental or unpre-

TABLE XII.

Operative Mortality.

	Operations	Deaths	Per cent.
September, 1922—August, 1923, inclusive	1864	121	6.5
September, 1923—August, 1924, inclusive	2474	141	5.6

Operative Mortality—Distributed.

	Operations	Deaths	Per cent.
September, 1922—August, 1923, inclusive.			
General surgical service	1471	74	5.0
Neuro-surgical service	393	47	11.9
September, 1923—August, 1924, inclusive.			
General surgical service	1967	88	4.5
Neuro-surgical service	396	46	11.6
Genito-urinary service	111	7	6.3

According to Service.

	Operations	Deaths	Per cent.
Division W	396	46	11.6
Division X	1076	57	5.6
Division Y	891	31	3.5
Division Z	111	7	6.3

ventable causes, but they occur with such regularity as to be prognosticated. William Mayo has said, "That which can be foreseen can be prevented." While this is not altogether true, yet a more careful pre-operative estimation of a patient's capacity to withstand contemplated operative procedures and a greater fortification of the patient's vital resources will undoubtedly lead to a further reduction in operative mortality.

In going over the deaths of the last year, I find they are tabulated in the following manner:

1. Patient's disease, 72.8 per cent.
2. Calamity, 6.3 per cent.
3. Error in judgment, 6.3 per cent.
4. Error in technic, 9.2 per cent.
5. Error in diagnosis, 5.2 per cent.

GRAPHIC CHART ILLUSTRATING MONTHLY OPERATIVE MORTALITY.

1922–1923—Red.
1923–1924—Blue.

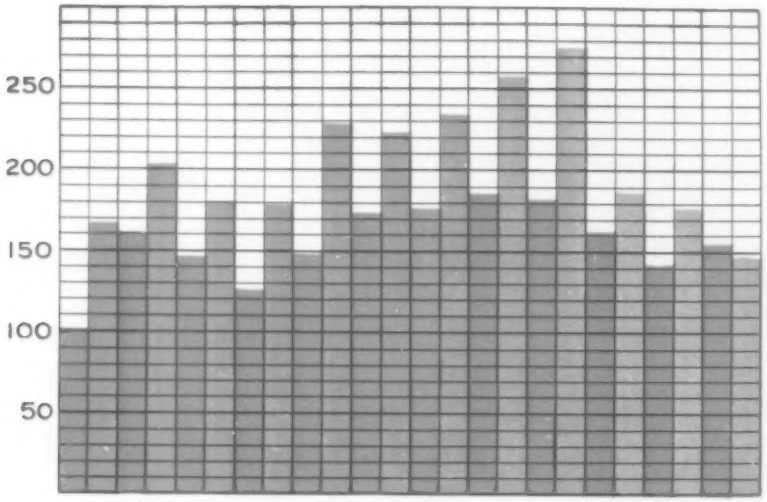
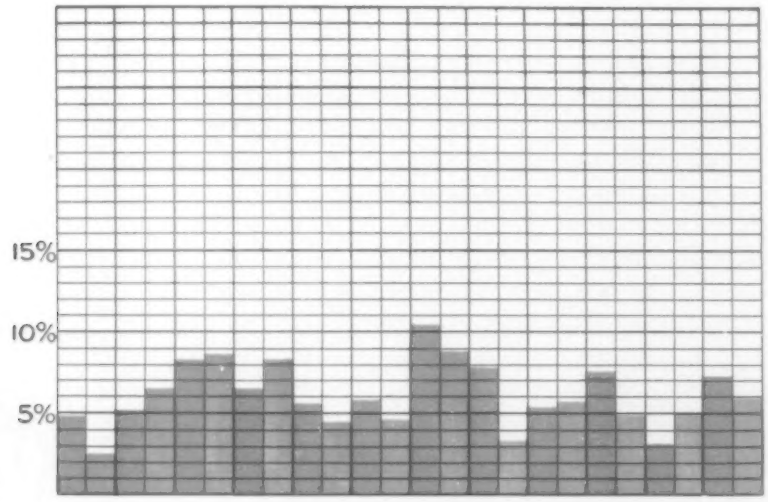


Chart No. 1.—Number operations.
Chart No. 2.—Percentage mortality.



A death is scheduled as Patient's Disease when, in the opinion of the staff, the patient should have been subjected to operation but succumbed because of the severity or extent of the disease. Under Calamity are included such catastrophies as embolus, acute cardiac dilatation and hæmiplegia. The staff decides that death was due to an Error in Judgment if the operation was ill-advised, ill-timed, if too much was attempted or if insufficient attention was paid to pre- or post-operative care. Error in Technic includes hemorrhage, infection, vicious circle, etcetera. Error in Diagnosis is self-explanatory.

TABLE XIII.

Classification of Deaths, Operative and Non-operative.

September, 1923; July, 1924, inc. Total deaths, 173.

	Number	Per cent.	
Patient's disease	126	72.8	79.1
Calamity	11	6.3	
Error in judgment	11	6.3	20.7
Error in technic	16	9.2	
Error in diagnosis	9	5.2	

Autopsy Record.

	Deaths	Autopsies	Per cent.
September, 1922; August, 1923	121	62	52.1
September, 1923; August, 1924	181	81	44.7
7.4% decrease			

While in the cases scheduled as error in diagnosis the error exists, the death may in reality be due to the patient's disease. An illustration of this is a death from acute pancreatitis diagnosed as acute intestinal obstruction.

An attempt is made to obtain an autopsy in every surgical death. The interne and surgical resident first attempt to obtain permission and failing, call a member of the service upon which the death occurred. During the period September, 1922, to August, 1923, inclusive, 52.1 per cent. of the patients who died were autopsied, and in a similar period in 1923–1924, 44.7 per cent. of autopsies were obtained. It is only by persistent effort that permission is received and every member of the staff must lend aid. The value of an autopsy in unravelling post-operative events is, I believe, beyond question.

The wound complications are discussed and rated at the weekly meeting. Cases are first classified as primarily infected or non-infected. Under primarily infected wounds are scheduled such cases as acute suppurative abdominal infections and bowel resections. Infections are rated as follows:

A. Stitch abscess, fat necrosis, serum accumulation or small hæmatoma.

B. Infection—slight—not impairing result.

C. Infection—causing death or impairing result.

As soon as a complication is evident an orange indicator is placed on the patient's bed card.

The wound complications for the year 1923–1924 are given in Table XIV, and a comparison is made between this and the previous year.

Table XV illustrates the pulmonary complications during the last two years. Table XVI is an analysis of these complications in the year 1923–1924. It is not within the limits of this paper to discuss the causes of pulmonary

TABLE XIV.

Wound Complications.

1923–1924	Operations	Complications	Per cent.	A	Per cent.	B	Per cent.	C	Per cent.
September	165	4	2.4	2	50	2	50	0	00
October	201	14	6.9	7	50	7	50	0	00
November	182	7	3.8	3	43	3	43	1	14
December	182	5	2.6	0	00	4	80	1	20
January	228	7	3.1	2	28	5	72	0	00
February	222	7	3.1	4	57	2	29	1	14
March	233	12	5.1	5	41.6	5	41.6	2	16.6
April	261	4	1.5	3	75	1	25	0	00
May	279	3	1.0	1	33.3	1	33.3	1	33.3
June	188	6	3.2	2	33.3	3	50	1	1.6
July	189	3	1.5	2	66.6	1	33.3	0	00
August	144	5	3.4	2	40	2	40	1	20
Totals	2474	77	3.1	33	42.8	36	46.7	8	10.3
1922–1923	1864	84	4.6	45	53.6	23	27.3	16	19.0
1923–1924	2474	77	3.1	33	1.3	36	1.4	8	.32
1922–1923	1864	84	4.6	45	2.4	23	1.2	16	.85

Seventeen of the 77 cases (22 per cent.) which had wound complications were classified as primarily infected under our classification. If these were subtracted it would show a percentage of 2.4 per cent. of cases having wound complications.

Cases classified as primarily infected are those of suppurative appendicitis, bowel resections, etc.

A. Stitch abscess, fat necrosis, serum accumulation or small hæmatoma.

B. Infection, slight, not impairing result.

C. Infection, causing death, or impairing result.

TABLE XV.

Pulmonary Complications.

1923–1924	Operations	Complications per cent.		Lived, per cent.		Died, per cent.	
September	165	2	1.2	1	50	1	50
October	201	3	1.4	1	33.3	2	66.6
November	182	2	1.9	2	100	0	00
December	182	3	1.6	2	66.6	1	33.3
January	228	0	0.0	0	0.0	0	00
February	222	2	0.9	2	100	0	00
March	233	2	.85	1	50	1	50
April	261	1	.38	0	0.0	1	100
May	279	0	0.0	0	0.0	0	00
June	188	2	1.0	1	50	1	50
July	189	2	1.0	1	50	1	50
August	144	2	1.3	1	50	1	50
Totals	2474	21	0.84	12	57.2	9	42.8
1922–1923 Totals	1864	32	1.7	17	52.1	15	46.8

complications. They are many. At the present time a commission has been appointed to investigate these.

As soon as there is any suspicion of a pulmonary lesion being present, the patient is seen by the medical consultant and a chest X-ray is taken.

TABLE XVI.

Analysis of Pulmonary Complications.

Of 21 Cases There Were 11 Cases of Pneumonia:

Of these..... 5 were broncho-pneumonia.
Of these..... 6 were lobar pneumonia.

Broncho-pneumonia.....	5 cases.	Deaths.... 2.	40%
Lobar pneumonia.....	6 cases.	Deaths.... 4.	66.6%

Distribution of Cases of Pneumonia According To Location of Operation.

Upper abdomen.....	3
Lower abdomen, including hernia and prostate.....	6
Fractures.....	1
General abdominal.....	1

Of the Cases that Died:

4 had ether 1 had gas-ether
2 had gas 1 had none

Of the Cases of Pulmonary Complications:

9 had ether.....	1.4%	of total cases having ether.
5 had gas.....	0.82%	total cases having gas.
4 had gas-ether.....	0.96%	total cases having gas-ether.
2 had spinal or local..	0.38%	total cases having spinal or local.
1 had none.		

Total.....21

TABLE XVII.

Other Complications.

1923–1924	Operations	Complications per cent.	Lived, per cent.	Died, per cent.
September	165	2 – 1.2	2 – 100	0 – 0.0
October	201	4 – 1.9	2 – 50	2 – 50
November	182	6 – 3.3	3 – 50	3 – 50
December	182	11 – 6.0	8 – 72.7	3 – 27.3
January	228	4 – 1.8	3 – 75	1 – 25
February	222	6 – 2.7	4 – 66.6	2 – 33.4
March	233	2 – 0.9	0 – 0.0	2 – 100
April	261	5 – 1.8	5 – 100	0 – 0.0
May	279	10 – 3.6	5 – 50	5 – 50
June	188	2 – 1	1 – 50	1 – 50
July	189	6 – 3	2 – 33.4	4 – 66.6
August	144	0 – 0	0 – 0	0 – 0.0
Totals	2474	58 – 2.4	35 – 60.3	23 – 39.6

Analysis of Other Complications.

	Lived	Died		Lived	Died
Intra-abdom. hemorrhage	1	1	Facial nerve injury	1	0
Decubitus	3	0	Embolism	2	3
Hemorrhage other than abdominal	4	5	Epididymitis	1	0
Phlebitis	4	0	Parotitis	4	0
Vicious circle	1	0	Psychosis	1	0
Cardiac	0	1	Duodenal fistula	1	0
Residual collection	4	0	Pylephlebitis	0	1
Cerebral œdema	0	1	Peritonitis	0	3
Jaundice	1	0	Erysipelas	1	0
Intest. obstruction	0	1	Shock	0	1
Infection thigh and soft parts	4	0	Meningitis	0	2
Biliary fistula	1	0	Uræmia	0	3
			Pyelonephritis	1	0
			Cystitis	1	0

The diagnosis of the type of complication is left entirely to the consultant. A red indicator is placed on the patient's bed card in these cases. Table XVII illustrates the incidence and analysis of complications other than pulmonary and wound infections.

The report of the follow-up service is given as from June, 1923, to June,

TABLE XVIII.

Follow-up Report; June, 1923–June, 1924.

Number of cases discharged	2189
Per cent., followed up at Follow-up Clinic	39.4
Per cent., followed up by Social Service	24.8
Per cent., followed up by mail	9.2
Total	73.4

Results....A....78.9%
Results....B....16.6%
Results....C.... 4.5%

Result A....Patient entirely relieved of all symptoms.
Result B....Patient relieved of major symptoms but still complaining of some minor symptoms.
Result C....Patient unimproved, made worse, or entirely dissatisfied with the operation.

1922-1923		*1923-1924*	
A	69.1%	A	78.9%
B	18.4%	B	16.6%
C	12.5%	C	4.5%
Total per cent. followed up	64.4%	Total per cent. followed up	73.4%

1924, since in the patients discharged after June 1, 1924, sufficient time had not elapsed to allow deductions to be drawn from the results obtained. The results here tabulated may have to be altered later, as in cases of malignant disease. The follow-up is conducted by a member of the service on which the patient was treated. We believe this to be the method of preference since only the surgeon who is acquainted with the preoperative history and the operative findings can properly correlate these with the end result. At the present time we are revising our follow-up system. In the future follow-up will be in charge of workers who have no actual duties in the Record Room. We have found that it is necessary to do this in order to have a follow-up system which is of any value. The added expense is well compensated for in an accurate knowledge of end results.

We have not attempted to draw comparisons between the present mortality and morbidity and that of years previous to 1922. Suffice it to say, that attention to details brought to light in unbiased statistical analysis and free discussion of the mortality and the morbidity have reduced and will further reduce these.

Figures must not be compiled if they are of no value. To be of value, they must be used, and to be used they must be accessible. Our short experience has led us to believe that full and completed records and systematically recorded statistics are a valuable library for future reference.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held February 11, 1925

The President, Dr. Eugene H. Pool, in the Chair

APPENDICITIS WITH GAS-BACILLUS INFECTION

Dr. Edwin Beer presented a man, fifty years of age, who developed a typical attack of appendicitis localizing in the right iliac fossa with temperature to 103. After five days the symptoms disappeared and recommenced on the seventh day. When seen by the reporter on the ninth day there was discernible a rather movable tender mass behind the right rectus muscle about the size of a peach. The patient was operated upon at once September 30, 1924, through a rectus muscle incision. An abscess was found between the coils of the small intestine, rather movable and containing a sloughed-off appendix with four ounces of pus and several coproliths. As the tissues were very friable, the operator was compelled to close the abdominal wall with interrupted chromic gut stitches taking the peritoneum, muscle and fascia. The patient stood the operation very well, but within 48 to 50 hours, instead of picking up, he was very much depressed and his general condition was very unsatisfactory. The wound was exposed, and to the outer side of the wound well towards the flank, there were two good-sized copper colored areas of skin, and by palpation to the outer side of the wound, there was a definite gas crackling. Incisions were made, gas containing pus evacuated, and peroxide injected. A Carrel-Dakin's dressing was immediately started. Examination of the smear and culture showed Welch's bacilli, colon bacilli, as well as streptococci. The next day the drained wound was opened further and as the tissue still crackled and there were several tender areas, the later incisions were extended well forward and more tubes introduced. Dakin's solution was continued for over a week until there was no more evidence of gas infection and until cultures showed no more Welch bacilli. During this time the patient's condition changed for the better rapidly, and extensive fascial sloughs were discharging from the wounds. By October 8 there were no more evidences of pus formation in the parietes and no more gas, and the patient was definitely on the road to recovery. It took almost another month before the wound was fairly well healed. As a result of the extensive sloughing, a weakness in the abdominal wall became manifest.

It is surprising, in view of the presence of these bacilli of Welch in the intestinal contents of many humans, that more patients with appendix abscesses do not develop parietal infections. The few cases that had come to his attention had almost regularly been fatal.

SPLENECTOMY FOR PURPURA HEMORRHAGICA

Dr. Edwin Beer presented two patients who had suffered from purpura hemorrhagica. They both presented the following features in common: (1) Progressive anæmia and weakness due to long-continued intermittent hemorrhages. (2) Typical blood picture of thrombocytopenic purpura

hemorrhagica, namely: *a*. Low platelet count. *b*. Normal coagulation time. *c*. Prolonged bleeding time. *d*. Positive tourniquet test. *e*. Failure of clot retraction. (3) Recovery and apparent cure following splenectomy.

CASE I.—A boy, aged fifteen, was admitted November 22, 1922, complaining of bleeding from the nose and vomiting of blood. The present illness began in April, 1919, when the patient had an attack of tonsillitis followed by hemorrhages into the skin, bleeding from the gums, painful joints, vomiting and pain in the upper part of the abdomen. He also had irritability of the eyes, weakness, fever, chills and sweats. He remained in the hospital for one month, after which he was apparently well except for an occasional ecchymosis following some slight trauma, until May, 1922, when he received a blow on the nose. This was followed by a severe epistaxis which continued for several hours. The bleeding was stopped by means of a tampon saturated with fresh normal blood. The skin hemorrhages had become more frequent since. In July, 1922, while drinking milk, blood began to issue from the anterior and posterior nares and soon the patient vomited blood and food. Some hemorrhagic areas again appeared on the skin. Röntgen-ray therapy was applied to the splenic region, with apparently good results. His condition improved. He lived a quiet life until November 22, 1922, when he was again struck on the nose, and he had been bleeding and vomiting blood ever since.

Physical Examination.—The patient was a well-developed and fairly well-nourished boy with marked pallor. There were a few petechiæ in the conjunctivæ of both lower lids. The teeth were in fair condition. The gums were spongy and bleeding, the tonsils large and covered with hemorrhagic spots. The heart was not enlarged. There was a systolic thrill and murmur at the apex. The spleen was not palpable, but it was large to percussion. There were numerous petechiæ over the back, chest, abdomen, thighs and legs.

On November 26, 1922, the blood count was: hæmoglobin, 45 per cent.; red cells, 2,584,000; white cells, 10,000; platelets, 10,000 (plasma); polymorphonuclear neutrophils, 71.6 per cent.; polymorphonuclear eosinophils, 1.6 per cent.; polymorphonuclear basophils, 0.3 per cent.; lymphocytes, 15.3 per cent.; and monocytes, 11 per cent. The coagulation time of the blood was ten minutes; the bleeding time four and one-half minutes. The tourniquet test was slightly positive. There was no clot retraction. The patient had secondary anæmia, thrombocytopenia and monocytosis. The blood picture was characteristic of essential thrombocytopenia.

During the following month there were a succession of hemorrhages from nares and gums, producing an anæmia so marked that transfusion was done December 17, 500 c.c. being injected. There were no hemorrhages after this transfusion, but successive crops of petechiæ formed. December 23, the hæmoglobin content was 28 per cent.; red cells, 2,010,000; platelets, 24,000. December 29, a second transfusion was done, 450 c.c. being injected. The following day, December 30, 1922, splenectomy was performed by Dr. E. Beer through a subcostal incision. There was profuse oozing of the wound. Continuous oozing from the nose occurred during the anæsthesia.

A soft, slightly enlarged spleen with omental adhesions between the stomach and hilus was found. The adhesions were doubly divided and cut. The spleen was delivered with some difficulty. The hilus was ligated and cut, taking special care not to include the adherent stomach.

Summary of pathologic report by Dr. F. S. Mandlebaum: The macroscopic specimen consisted of a moderately enlarged spleen weighing 300 gm. and measuring 14 x 7.5 x 3 cm. It was elastic and cut easily. Malpighian bodies were visible. Microscopic examination showed only hypertrophy. No blood platelets were found.

Immediately after the removal of the spleen, all oozing of blood stopped from the wound and nose. The same effect was noted for the bleeding time as in the previous case.

The bleeding before splenectomy was profuse at the end of six minutes, when it was stopped. The bleeding time during manipulation at the hilus was six minutes; immediately after splenectomy, three minutes; two hours after splenectomy, three minutes; eight hours after splenectomy, three minutes; and fifteen hours after splenectomy, two and one-half minutes (Tables 3 and 4.

January 19, 1923: The patient was out of bed. Many petechiæ appeared on the legs and a few on the right lower conjunctivæ.

February 3, 1923: A few petechiæ on the face and lower legs appeared from time to time. The gums had improved; there was no sponginess and no bleeding.

February 8, 1923: There were hypostatic petechiæ on the legs only. The general condition was excellent. The hæmoglobin content was 76 per cent.

February 14, 1923: For the first time clot retraction was present. There was a thrombocytopenia and slight positive capillary resistance test. The petechiæ were disappearing from the legs. There had been no hemorrhages since February 9, 1923.

February 17, 1923: The patient was discharged well.

Blood changes following splenectomy:

(1) Hæmoglobin and red blood cells:: The transfusion of 500 c.c. before splenectomy raised the hæmoglobin to 48 per cent. and the transfusion given immediately after the operation produced a further rise to 60 per cent. and a rise to 3,232,000 red blood cells. This gradually dropped during the first four days to 38 per cent. hæmoglobin and 2,832,000 red blood cells. Improvement then began and at the last examination (April 6, 1923) the hæmoglobin was 81 per cent. and the red blood cells were 4,840,000. Normoblasts and Howell-Jolly red cells were occasionally present.

(2) White blood cells: Just before the operation there was a leucocytosis of 22,000; six hours after the operation the leucocytes were 36,000, and on the following day they rose to 55,000. The differential blood picture after the post-operative polynucleosis showed a persistent monocytosis (increase of the large mononuclears and transitionals).

(3) Blood platelets: The day following the operation there was a slight rise to 31,200; then a gradual fall to 1000 on the third day after the operation. After this there was a gradual increase to 10,000 and then to about 20,000. The morphology remained about the same. The day following the operation a few giant blood platelets appeared in the smears.

(4) Bleeding time: For a month and half this was prolonged, usually over two minutes, and even as long as twelve minutes. This became normal (two to three minutes).

(5) Tourniquet test (capillary resistance): This was constantly positive until the third month after the operation. It then became constantly negative.

(6) Clot retraction: There was no clot retraction for six weeks after the operation. This appeared on February 14, 1923, and slight clot retraction remained present, although the blood platelets remained low. It is interesting to note that the blood of this patient never showed clot retraction on previous examinations.

Summary.—This was a case of chronic thrombocytopenia of four years' duration. The patient's condition became worse as time went on; the bleeding was more frequent and more severe. Splenectomy brought about a turn for the better and the patient has steadily improved since.

The patient was again seen in April, 1923. He had had no hemorrhages since he left the hospital. He had gained weight and strength steadily. Static purpura of the legs did not occur. Examination of the blood still showed a thrombocytopenia (blood platelets, 22,000), but all other evidence of the previous condition was absent. The capillary resistance test was negative and clot retraction was present. At present (February, 1925) the patient is entirely well.

CASE II.—History: A young girl, aged seventeen years, was admitted on October 9, 1924, to the First Medical Service, complaining of uterine bleeding for nine months, black and blue spots of skin and bleeding from mouth two weeks, and bloody urine two days. About nine months before admission to the hospital, she noticed that her menses occurred three days before the usual date and that the period lasted several days longer with profuse bleeding. At that time she began to find black and blue spots on her skin, especially after the slightest bruise. About March, 1924, she began to bleed from the gums. October 7 she felt some pain in her left loin and since then she noticed that her urine was bloody. The blood in the urine has become less.

She appeared a well-nourished and well-developed girl, not acutely ill. Petechial hemorrhages were present on the mucous membranes of the mouth (gums, lips and fauces) and petechiæ and ecchymoses were present on all parts of the skin. The heart and lungs showed no abnormalities. The liver was not felt, but the spleen was easily felt, and extended two fingers below the costal margin.

Laboratory Examinations. (1) Urine—bloody at first, but later clear. (2) Blood, Wassermann—negative.

Blood

Hæmoglobin	94%	Bleeding time	42 minutes
Red blood-cells	5,120,000	Coagulation time	8 minutes
White blood cells	12,600	Tourniquet test	Positive
Platelets	10,000	Clot retraction	None
Polys. neut.	64.6%	Temperature	98° to 99°
Lymphocytes	31.3%	Pulse	88/120
Monocytes	4.0%	Respiration	20-24

Platelets very large.

The condition of the patient did not improve on the usual medical treatment and after a week in the hospital she began to menstruate profusely. She complained of feeling weak and this was reflected in the blood examinations. The hæmoglobin and red blood cells began to drop rapidly. October 18, 1924, the hæmoglobin was 69 per cent. and the red blood cells were 3,890,000. Pallor was becoming marked and the hemorrhages in the skin and mucous membranes increased. Splenectomy was done October 24, 1924, by Dr. Edwin Beer. Ether was used as an anæsthetic. A long left subcostal incision was made. The spleen was found high up under the diaphragm, adherent posteriorly and anteriorly. The spleen was not much enlarged and did not extend below the ribs. At the hilum of the spleen an accessory spleen, the size of a cherry, was found. No intraperitoneal bleeding was noticed. The patient stood the operation well. The pathologist reported no abnormal changes in the spleen except a relative increase in the number of Malpighian bodies.

The post-operative course was very stormy. The hæmoglobin kept steadily going down and November 1 reached 33 per cent. A blood transfusion of 500 c.c. was again given, but with little effect. The progressive fall in the hæmoglobin was due to the menorrhagia which was not checked by the splenec-

tomy. The bleeding into the skin and mucous membranes, however, stopped. November 8, radiotherapy to the hypogastric region to check the hemorrhage from the uterus was done. After this her bleeding became less and a week later the uterine bleeding stopped. She was then transferred to the medical side November 16, with the wound almost healed. From then on she improved steadily and was discharged well December 3, 1924. Her hæmoglobin on discharge was 62 per cent.

A few of the blood examinations done since the splenectomy show the following:

	Oct. 29, 1924	Nov. 5, 1924	Dec. 11, 1924
Hæmoglobin	35%	29%	62%
Red cells	2,464,000	1,960,000	4,320,000
White cells	30,400	50,800	18,000
Platelets	12,000	10,000	80,000
Polys. neut.	85.3%	90%	78.5%
Lymphocytes	12.6%	8%	11.0%
Monocytes	2.0%	2%	8.0%
Coagulation time	8 min.		9 min.
Bleeding time	6 min.	7 min.	2 min.
Tourniquet test	Neg.	Neg.	Neg.
Clot retraction	None (24 hrs.)		Normal

The blood platelets do not show any great increase at first, compared to their number before operation. The leucocytosis has persisted. At present the blood picture is gradually assuming a normal aspect.

The platelet count went up after operation and then dropped to pre-operative figures, but never returned to normal.

PERINEAL URETHRAL URINARY FISTULA

Dr. Edwin Beer presented a man, thirty-three years of age, who was admitted May 31, 1924, with a perineal urinary fistula which had followed a perineal incision of a prostatic perineal abscess. A stricture in the deep urethra was present. The perineal sinus was minute but allowed urine to escape. Various attempts were made to close the sinus. After some weeks of treatment by permanent catheters, July 25, 1925, the fistula was excised to the urethra close to the strictured area. As the urethra was friable, it could not be sutured, and an indwelling catheter was introduced. The wound was packed with iodoform gauze. When the catheter was withdrawn, leakage began anew.

October 28, 1924, renewed examination showed in the floor of the urethra just anterior to the compressor muscle a sinus that admitted a small ureter catheter; fluid injected into this appeared in the perineum. The urethra admitted a No. 24 Fr. cystoscope. At this time half of his urine passed through his perineum.

November 11, a probe passed into the fistula could be felt under the anterior rectal wall. Over the probe a grooved director was pushed into the rectum and on it, the anal sphincter was cut as in a fistula-in-ano operation. The wound was curetted and packed for a few days and then allowed to granulate. The sinus rapidly healed and by December 3 the patient was discharged without any urinary leakage and has now for some time complete closure of the perineal incision without any of his old trouble. The reporter believed that spasm of the anal sphincter had prevented proper drainage and in this way kept the fistula open.

MULTIPLE RIGHT KIDNEY ABSCESSES; CHOLELITHIASIS; GANGRENOUS CHOLECYSTITIS; RUPTURE OF GALL-BLADDER

Dr. Edwin Beer presented a man, twenty-seven years of age, who was admitted October 16, 1924. He was seized ten days before admission with a chill, colicky pain about the navel, nausea and vomiting. Colicky pains lasted for two days and then there was a piercing pain in the right upper quadrant which has persisted for last eight days. This pain radiated to back and at times to right shoulder. The night before admission this radiating pain was most severe. Temperature varied from 100 to 103 since the beginning of the trouble. Constipation was marked. There was no icterus and no urinary symptoms. On admission the patient was acutely ill, very tender and rigid in the right upper quadrant below the liver, where there was also rebound tenderness. Suggestion of a mass was felt in this region. There was also very well-marked tenderness in the right costo-vertebral angle. Urinary findings on admission showed microscopic pus.

Upon cystoscopy it was found that as soon as the catheter entered the right pelvis, the patient's pain ceased. The right kidney showed no indigo-carmin output, diminished urea with pus cells; and the left kidney secretion showed strong indigo-carmin, good urea and was microscopically negative. The specimen of urine from the right kidney contained staphylococcus aureus in the culture. As the patient was relieved of his pain by the passage of the catheter into the right pelvis, it was suspected that there was a stone obstruction in the upper ureteric region, and though there was no evidence of retention, it was determined to leave the catheter in place. The patient's blood counts varied from 17 to 24,000 with 84 to 88 per cent. polymorphonuclears. The blood urea was 19.6 and the phenolsulphonephthalein test was 70 per cent. in two hours. X-ray examination for stone was negative, but there was a slight elevation of the right half of the diaphragm. Despite indwelling catheter during the next few days, the patient continued to run high temperatures, after a primary drop to 100.2, reaching at times to 104. Anterior abdominal examination showed very little tenderness, whereas the right costo-vertebral angle showed exquisite tenderness.

October 24, 1924, the right kidney was exposed by lumbar incision; multiple cortical abscesses were revealed after the kidney had been decapsulated *in situ*. Some of these were situated on the anterior surface; others on the convexity, and several smaller cortical abscesses in the posterior aspect of the lower and upper poles. The perinephric tissues were consolidated, thickened and œdematous. Drainage was instituted with two sheets of rubber dam placed between the kidney and the reflected capsule. The wound was left wide open. Despite this procedure, the patient did not improve and the kidney was palpated regularly in the wound and several other suppurating foci were broken into. His temperature continued as high as 104, and November 7, under gas, the finger was swept all around the kidney, and it was evident that in the upper pole, which had grown much larger, other abscesses were forming. Some of these were broken into with the finger and drainage instituted as in the first operation. November 11, as there was no improvement, the patient was delirious and temperature was still high, a rapid nephrectomy was performed, and it was thought that now the patient would improve as the septic focus had been removed. The kidney was three to four times normal size and studded with numerous carbuncular suppurating areas containing staphylococcus aureus, as did the original abscesses and the right kidney urine specimen. November 16, the patient, having slightly improved after the nephrectomy, began to complain of severe abdominal pain, and his temperature

rose to the high level that it had originally occupied and tenderness developed anteriorly under the right costal arch. The wound showed no retention but an occasional discharge of urine, which was evidently a reflux from the bladder up the ureter of the nephrectomized side. The patient was vomiting and delirious and looked very septic. Rigidity was manifest over the right upper quadrant anteriorly. November 19, as there was no improvement, an exploratory subcostal laparotomy was done, and a ruptured gangrenous gall-bladder was encountered. It was full of stones and surrounded by omentum between which and the gall-bladder there were several ounces of pus and bile. The gall-bladder was removed and the wound closed down to a drain. The pus in the gall-bladder showed colon bacilli.

After this operation, the temperature rapidly dropped to normal, and convalescence progressed smoothly.

The patient was discharged December 23, 1924; has regained his health and at least 25 pounds in weight.

GALL-STONE-FECOLITH BOWEL OBSTRUCTION

Dr. Edward D. Truesdale presented a woman, aged seventy-five, who was admitted to St. Luke's Hospital, April 19, 1924. There was a history of six days of abdominal pain, vomiting and constipation. For twenty-four hours the vomiting had been fecal in character. Upon examination the abdomen was found distended; there were no masses or points of tenderness. There was visible peristalsis. The rectal examination was negative. The pre-operative diagnosis was complete intestinal obstruction, probably due to a new new-growth in the region of the cæcum or ascending colon.

Upon opening the abdomen through a midline incision the course of the large bowel was palpated without discovery of the cause of the obstruction, although an extensive area of firm adhesions was encountered in the right upper quadrant. The cæcum was then inspected, which was found to be normal, while the terminal ileum was found to be collapsed. Following the collapsed ileum upward a short distance, a foreign body was encountered, causing a complete occlusion of the lumen of the bowel. The small intestine above this point was greatly distended. The foreign body was pushed upward a little and, upon removal through a small incision, found to be a fecolith. The opening in the bowel and the abdominal incision were closed, the patient making a prompt and uneventful recovery.

The fecolith upon examination was found to be laminated in structure and both in the X-ray and upon section revealed a small nucleus, apparently a gall-stone. It was thought that the area of adhesions about the gall-bladder substantiated this theory, although the patient does not give a convincing history of gall-bladder disease.

N. B.—It is interesting to note that a well-marked pouch-like Meckel's diverticulum was found in the collapsed portion of ileum. This presented no evidences of inflammation, present or past, showing that these may be present through a long life's course.

Dr. Winfield Scott Schley said he had had three of these cases, two within three months of each other, and the third ten years afterward. The first case was an old lady of sixty years, who was operated upon under local anæsthesia the fifth day of her illness and a large gall-stone was removed from the lower end of the ileum. He showed the stone removed. Three months later a similar case of complete obstruction in a man seventy-four years of age entered the hospital on the fifth day after onset of symptoms,

and was operated under local anæsthesia. Both recovered, making a very uneventful convalescence, although operated late. Neither case gave definite history of biliary history in the past. The stone from the second case was very large, ovoid, smooth, and showed laminations, and while not sectioned, seemed to have a gall-stone nucleus. The third case occurred ten years later in an old lady of ninety-one years of age following overindulgence at the table. She had had numerous attacks of intestinal pain and disturbance and was constipated. Operation was refused by patient and family. At autopsy an enormous calculus was found in the lower ileum, irregular, very dark and resembling a lump of coal. A perforation was found between the gall-bladder and duodenum that was apparently of ancient date. In this case there was a history many years before of a very severe attack of epigastric and right hypochondriac pain.

Most of these cases of entero-lithiasis are due to the impaction of gall-stones or to the formation of enteroliths, the nucleus of which is frequently a gall-stone. Lichtenstein, out of 1541 cases of intestinal obstruction, found that 41 of his series were due to gall-stone impaction. Wising found that in 51 cases of intestinal obstruction due to gall-stones that 38 died. The calculus may become impacted anywhere in the small gut from the duodenum to the ileo-cæcal valve, usually in the lower ileum. The history usually points to previous attack or passage of gall-stones, or, if the calculus has entered by ulceration, to an antecedent attack of localized peritonitis in the region of the gall-bladder.

Dr. William B. Coley said that he had had only one case of obstruction due to gall-stones and this had occurred about five years ago in a woman sixty-five years of age with a history of acute obstruction for four or five days. Although many kinds of cathartics and enemas had been given, they had had no effect. It was, however, decided to delay operation for a few hours and in the meantime to continue using enemas. A large gall-stone about the size of an English walnut was finally evacuated and the patient made a good recovery.

Dr. John Douglas said that the question of the ulceration of these stones out from the gall-bladder is very interesting. He has had two cases where a large stone was in process of ulceration into the duodenum at the time of operation and he had one case of obstruction of the small intestine by a stone. But the most interesting of all these cases was one on which he had operated four or five years ago, a woman who complained of vague pains over the abdomen, mostly on the right side. At the time of operation a right rectus incision was made and the urinary bladder was found adherent to the edge of the liver. On separating the two, below, there was another mass which appeared to be a carcinoma of the transverse colon. On attempting to separate that he opened into the large intestine, and there was found a large stone 2.5 cm. to 3 cm. which had escaped from the gall-bladder, and had tried to ulcerate into the urinary bladder, but had not succeeded in perforating it; but had ulcerated so that it stuck half-way into the colon. The gall-

bladder had shrunk after the stone had been discharged and was one-tenth the size of the stone. The patient had a bad infection of the wound but has healed up without hernia.

LYMPHOSARCOMA OF THE STOMACH

DR. HAROLD E. SANTEE presented a man, fifty-eight years of age, who was admitted to Bellevue Hospital, September 16, 1924, with the following relevant history. For two years he had suffered from pain in the epigastrium, dull and aching in character, at times made worse, at times relieved by food or water. Always relieved by alkalies. About three months before admission there was an acute attack of severe pain lasting about three hours. Acid and gaseous eructations had been present practically since onset. Patient vomited for first and only time a few days prior to admission. No blood in vomitus, none ever noticed in stools. Had lost in weight about twenty-five pounds in two years. He was well developed but poorly nourished. There was tenderness on deep pressure in mid-epigastrium and just to left of this. Wassermann negative, urine negative, blood negative, except for slight anæmia. Chest X-ray negative. X-ray study of the gastro-intestinal tract revealed the presence of a large niche formation on lesser curvature near junction of pars media and pylorus with marked irregularity of the lesser curvature. Diagnosis—malignant ulcer of lesser curvature with infiltration.

FIG. 1.—Lymphosarcoma of stomach.

At operation, September 26, 1924, the following pathological findings were found: Saddling the lesser curvature at pars media was a mass about one and one-half inches in diameter, indurated, somewhat irregular, showing infiltration of both walls of stomach about the lesser curvature, with puckering of the serous coat and of contiguous gastro-hepatic omentum. In the centre of this a depression suspicious of a crater. The mass is mobile and there are no evidences of metastases or other tumors.

A finger was then introduced through the transverse mesocolon and on this

as a guide, the gastro-hepatic and gastro-colic omenta were then doubly ligated and cut and the portion of stomach including the tumor mass from pars media to first portion of duodenum was resected. The duodenum was closed and inverted. A retrocolic gastrojejunostomy was then done after narrowing a too wide four and a half inch stomach opening down to about three inches by suture downward from the lesser curvature. The proximal jejunum lay toward the lesser curvature. The edges of the transverse mesocolon were sutured to the stomach surface about three-fourths inch proximal to the anastomosis.

The patient's post-operative course was smooth and the wound healed primarily. Slight epigastric distress was present for two or three days when the first soft diet was given. This disappeared promptly and he was discharged on the twenty-first day post-operative.

His pathological report showed as follows: Microscopic examination (Fig. 1) shows a superficial area of ulceration. Under it and under the better preserved mucous membrane lying at either side of the ulcerated area are numbers of lymphocytes which are densely staining and arranged in more or less sharply circumscribed foci. These lymphocytic collections are surrounded by diffusely arranged small cells of the lymphocytic type which stain less intensely and are perhaps slightly larger than in normal circumstances. These cells may be seen throughout almost the entire thickness of the stomach wall, infiltrating and destroying the muscular tissues of the part. In places they are arranged as broad, sheet-like groups; in other places they may be seen lying between the muscular remnants as small foci of various shapes.

Histological Diagnosis: Ulcerated lymphosarcoma of stomach. (Doctor Symmers.)

One month after operation he complained of transient nausea and slight drawing pain in epigastrium after eating, but since getting home he has been well, free from pain, and had gained eighteen pounds up to ten days ago. Following Sternberg's warning that an acute leukosarcomatosis may terminate this condition with an acute leukæmic blood picture and a general lymphatic or embolic involvement, his blood has been followed and on February 1, 1925, showed hæmoglobin 93 per cent. (Dare); red blood corpuscles 4,800,000; white blood corpuscles, 7200; polymorphonuclears, 74 per cent.; lymphocytes, 21 per cent.

X-ray examination of the site of operation February 4, 1925, reveals the following—the pylorus and duodenum are not visualized. There is a gastro-enterostomy present with moderately rapid evacuation, and no tenderness at site of the stoma. Examination at the end of six hours shows no gastric retention. Head of the column in cæcum, tail in ileum. Examination at the end of 24 hours shows the head of the column in rectum, tail in cæcum.

Dr. John Douglas said that he presented a case of lympho-sarcoma of the stomach before this Society in 1918 and the report was published in the Annals of Surgery in 1920. The man is now perfectly well without sign of recurrence, more than six years after operation. If these cases recover from the operation they have a better chance for life than carcinoma cases as they do not metastasize so early. The average age of incidence of sarcoma is forty-one as against sixty-one of carcinoma. Very few late results have been published.

FRACTURE LOWER END OF RIGHT FEMUR WITH PIN TRACTION AND TONG SUSPENSION

DR. HAROLD E. SANTEE presented a man, thirty-three years of age, who was admitted to Bellevue Hospital, April 27, 1924, having been thrown off the running board of a Bellevue ambulance in collision and fractured his right femur. He was brought immediately into the wards showing all the clinical signs of fracture of the femur about three inches above the condyles. X-ray showed a transverse fracture at this site with flexion of the lower fragment by gastrocnemius action to such a degree that its anterior surface markedly cleared the posterior surface of the shaft above. Some overriding was already

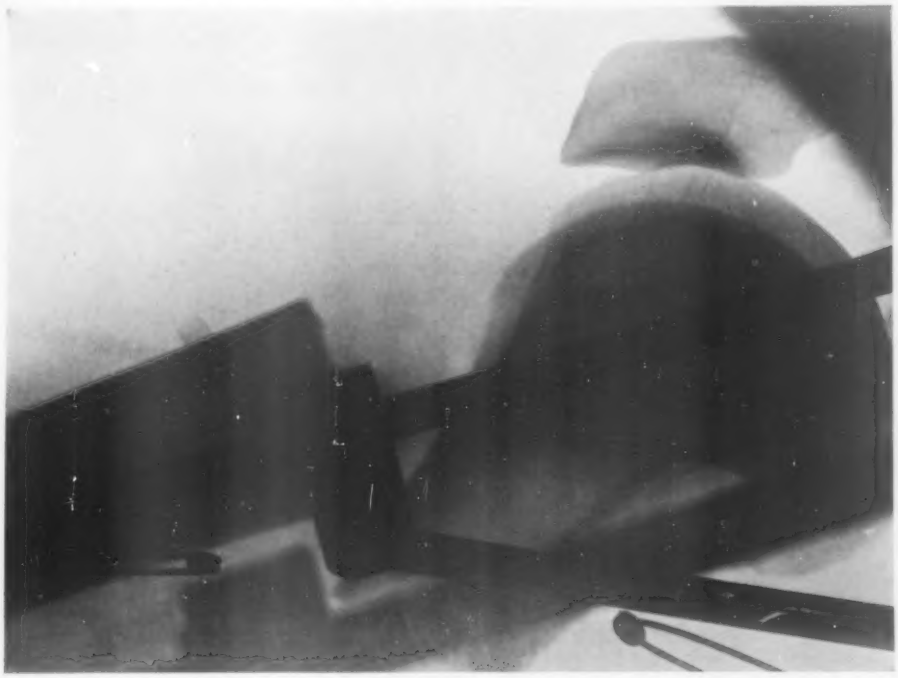


FIG. 2.—Thirty pounds pull through Steinmann pin in tibia; knee-joint about 30 degrees flexed. Note marked backward tilting of lower fragment. X-ray after third day.

present. Since in fractures of this particular type and location in adults it had been found very difficult to give them a good position, they had resorted to skeletal traction through the knee-joint by a Steinmann pin through the tibia, the knee being partially flexed on the Pearson attachment with the Thomas splint. Even then good X-ray appearance has been difficult to obtain, although the functional result had been fair.

This man was immediately Steinmann pinned and 25 pounds traction applied. After 24 hours this was increased to 30 pounds, which cleared the fragments as to overriding in from 48 to 72 hours. Anteroposterior displacement still maintained itself in spite of padding and various degrees of flexion of the knee-joint. After six days the sharp tongs were inserted into the lower fragment and an overhead pull with eight pounds placed on the tongs. This promptly overcame the flexion of the lower fragment, in fact, overcorrected it, so that it was gradually dropped back to two pounds. With a balanced adjustment between the pin weights and the tong weight, the fractured surfaces engaged and the tongs were removed at the end of

twelve days. Even after this time there was a slight return of the displacement of the lower fragment. The Steinmann pin with gradually decreased weights was left in place for fifty-one days as clinically union was slow. Following light skin traction for nineteen days longer, he was allowed out of frame and in a walking caliper splint, actively extending completely and flexing about 40° at the knee-joint. His further progress has been uneventful except that at no time has he shown more than a moderate amount of calcified

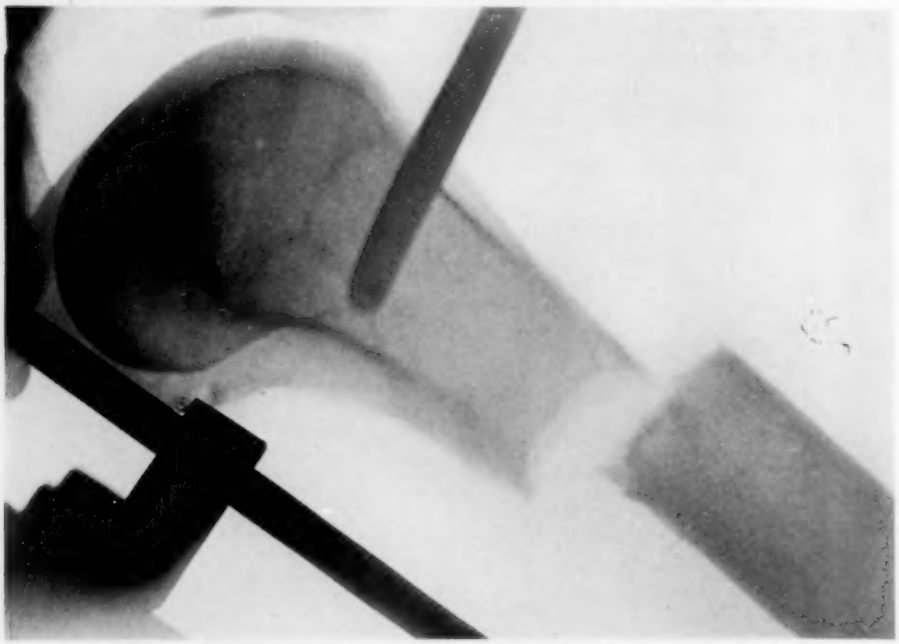


FIG. 3.—Upward pull on tongs—8 pounds—12 hours.

callus. For this reason he has continued to wear his splint longer than usual and only for the past four days has he discarded it completely.

OCHRONOSIS

DR. HAROLD E. SANTEE presented a woman, sixty years of age, who was admitted to Bellevue Hospital, November 19, 1924, with the following history: In 1892, following the birth of her last child, the woman had swelling and œdema of both legs which incapacitated her for four or five months. Shortly after this, small infection developed on right leg followed by an ulcer. This was treated for two years with various ointments; then in hospital dispensary for another two years, but failed to heal as she was active all the time.

In 1896, an ulcer developed on the left leg. Due to failure of the ulcers to heal and their gradual increase in size, she began treating them herself twenty-five years ago with carbolic ointment, first using the ointment only once a day, but liking its anæsthetic effect on the ulcers, she gradually increased the use of the ointment until on admission to the hospital she was redressing the ulcers of each leg practically every two hours and had been so doing for the past five or six years.

Twenty-three years ago after using the carbolic ointment for a little over a year, she noticed that upon her forehead and over her cheek bones there had

formed a bluish ink-like discoloration. In the course of the following five years this gradually appeared over the ears, knuckles of the hands and about the elbows. Her friends also called her attention to the fact that the whites of her eyes showed blackish discolored areas. During the past ten years the bluish areas over the forehead and over the cheek bones have gradually lost their bluish color and have become brownish in color. Similarly small areas on neck, chest and forearms have assumed a brownish color.

At no time during the course of this condition has she suffered from any physical disability outside of that attached to the ulcers of the leg. Coincident, however, with the disappearance of the bluish pigmentation from the forehead

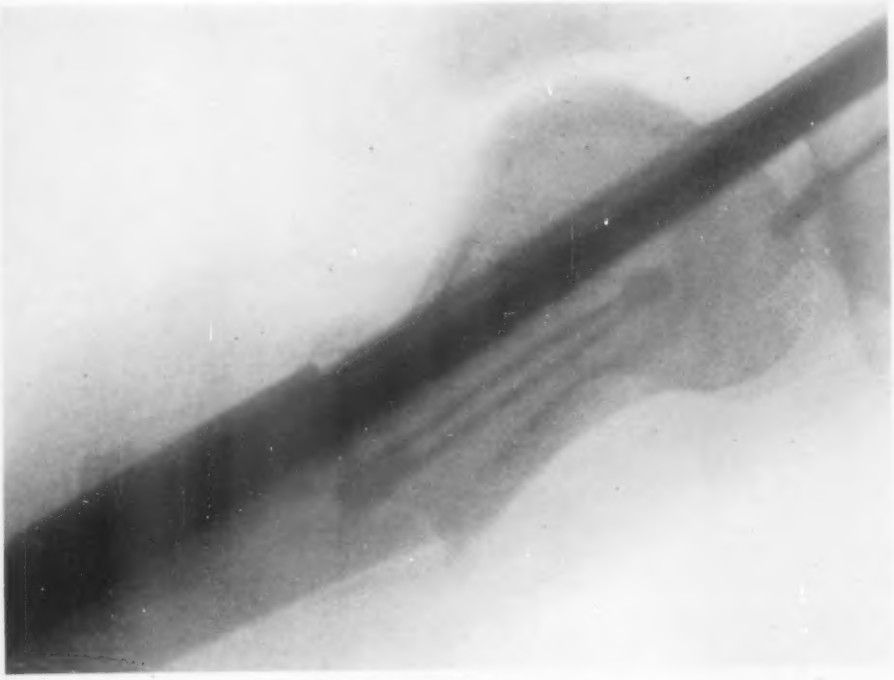


FIG. 4.—Final result—lateral view.

and cheek bones, she noticed a marked increase in the pigmentation on her hands, both on the dorsum and on the palms. The ulcers in spite of the use of carbolic ointment gradually increased in size, became very painful and disabling to patient and she finally sought relief at the Bellevue Hospital.

When admitted both legs at the junction of middle and lower thirds presented circumferential ulcers about eight inches in width with edges presenting a clean punched out appearance. Bases smooth, markedly calloused, fairly tender, with a thin layer of granulation tissue covering the bases. Slight purulent discharge, odorless, was present. Slight varicosities of both legs.

The most interesting feature was a bluish-black pigmentation involving the cartilages of the ear; slightly in the cartilages of the nose; markedly involving the skin over the dorsum of the hand, especially in the region of the knuckles and well-marked in the palms of the hands. Also small areas over the elbows. The sclera of each eye shows a similar pigmentation, brownish-black in color, either side of the cornea. There is a deep brownish pigmentation of the forehead, nose and cheeks, in fact involving practically the entire

face and extending down over the neck onto the chest. The forearms are similarly brownishly pigmented.

The arrangement of this pigmentation is definitely symmetrical and on picking up the skin seems to lie in the deeper layers of the skin itself as well as in the cartilaginous portions where directly subcutaneous. A small segment of skin was removed from the dorsum of the hand for pathological examination, which showed a brownish pigmentation of many of the fibroids in the subepithelial tissues. The discoloration gives a smooth appearance to the fibroids. No granules are visible. The urine on repeated examinations was found to be negative for alkapton or carbolic acid, although the first specimen

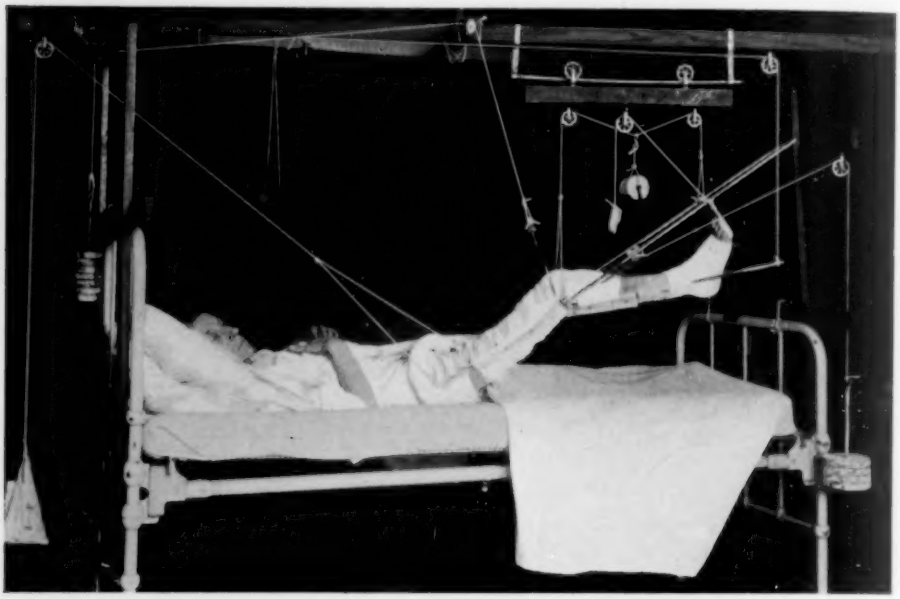


FIG. 5.—Low transverse fracture of femur. Steinmann pin through tibia. Sharp tongs overhead suspension of lower fragment.

on admission showed a slight smokiness on standing for a short time.

X-ray examination of the hands, March 19, 1921, showed atrophy of the bony structures of the hand but no productive or destructive osteo-arthritis. A similar condition of the knee-joints showed on X-ray.

The patient was kept in bed with red wash dressings for a few days, then dakinization of the ulcers was begun. The ulcers cleaned up, improved markedly for a time, and it was recommended that operation should be done with the hope of getting a greater blood supply through the calloused base of the ulcers on which skin grafts could be placed. This procedure she was averse to, however, and left the hospital only improved. Her subsequent course since this time has been a return to the carbolic acid ointment with apparently a marked deepening of the ink-like pigmentation on her hands and perhaps an increase in the size of the scleral pigmentation as well.

In 1866, under the title of *ochronosis*, Virchow described a condition characterized by the deposition of brownish, blackish or bluish-black iron-free pigment, particularly in the cartilaginous structures of the body, but also in tendons, joint capsules, periosteum and certain internal organs, this pigmentation standing in close relation to melanin. Clinically the pigmentation is most frequently noted in the cartilages of the external ear, nose, scleræ

and skin. Pathologically the costal cartilages, the intervertebral discs, the articular surfaces of large joints and the rings of the trachea are almost constantly pigmented. Occasionally the intima of the aorta and heart show pigmentation. In the cartilages, the deposit of the pigment takes place in the matrix, capsule and cell being spared or only slightly affected.

In a considerable number of cases, ochronosis is attended by destructive lesions in the larger joints, sometimes giving rise to symptoms comparable to arthritis deformans. In about half of the cases, the urine is characterized by the presence of homogenistic acid or alkapton. This homogenistic acid being derived chemically from the incomplete breaking down of the protein in metabolism, particularly tyrosin and phenylalanin. Doctor Dakin who has worked much in this subject holds that the homogenistic acid may be an abnormal product of metabolism rather than an intermediate product in normal metabolism.

In about half the cases of this metabolic disturbance that have come under observation, a history of the long-continued use of carbolic acid as a dressing has been noted. Whether this so influences protein metabolism as to cause the formation of homogentisic acid in the tissues and its liberation through the urine, has not been determined.

It is interesting to note, however, that normal cartilage immersed in a dilute solution of homogentisic acid will take on the same blackish or brownish-black pigmentation that is shown in this type of case. No case has been known to die as a result of this metabolic disturbance and it seems not incompatible with a long life.

Dr. Frank S. Mathews said that the description of the pigmentation in the case of ochronosis reminded one of a condition well known in the silky fowl. The fowl is named because of a condition of the feathers, but bone ends, intermuscular septa, dura mater and subcutaneous tissue are the seat of a deep pigmentation.

CURE OF INTESTINAL LYMPHOSARCOMA BY TOXIN AND RADIUM

Dr. William B. Coley presented a man, thirty-four years of age, who was referred to him in January, 1918, by Dr. Charles H. Mayo. The man had always been in good health until July 3, 1916, when he fell from a building, a distance of eighteen feet, striking on a cement floor, landing in such a position that his upper abdomen received a hard blow from his doubled-up elbow. Several months later he began to feel pain in the upper left abdomen, at the site of the injury. In the middle of December, 1916, he went to the Mayo Clinic, where Dr. Charles H. Mayo performed an exploratory operation, which revealed a large tumor of the mesentery and small intestine, eight inches in diameter. The tumor involved such a large segment of the mesentery that it was deemed unwise to attempt to remove it surgically, and the wound was closed. The patient was then referred to Doctor Coley for toxin treatment. Physical examination January 7, 1918, showed a recent cicatrix, four inches long, over the left rectus muscle, the upper area of which was not entirely healed. Just underneath this incision was a solid tumor about eight inches in diameter, not deeply attached, but apparently connected with the mesentery or intestine. No enlarged glands could be felt. His general condition was good, he had no pain nor any marked loss of weight. Blood examination was negative. The patient entered the Memorial Hospital immediately and was put upon combined treatment of radium and toxins. January 8, 1918, he received his first radium-pack treatment, consisting of 20,000 mc.

hours at 10 cm. distance; February 7, 1918, a second pack of 16,000 mc. hours at 10 cm. distance was applied. March 3, 1918, he had another treatment with 10,000 mc. hours at 7 cm. distance. He was made very ill by the radium. Five days after the first treatment, the toxins were begun in small doses, one-half minim; he proved very susceptible and developed a high temperature, 103°, from a dose of 2½ minims. After the first week's treatment, the tumor decreased about one-half in size and had become much more mobile; steady diminution in size was noted. The patient returned to his home on the Pacific coast, and the toxins were continued there by his family physician.

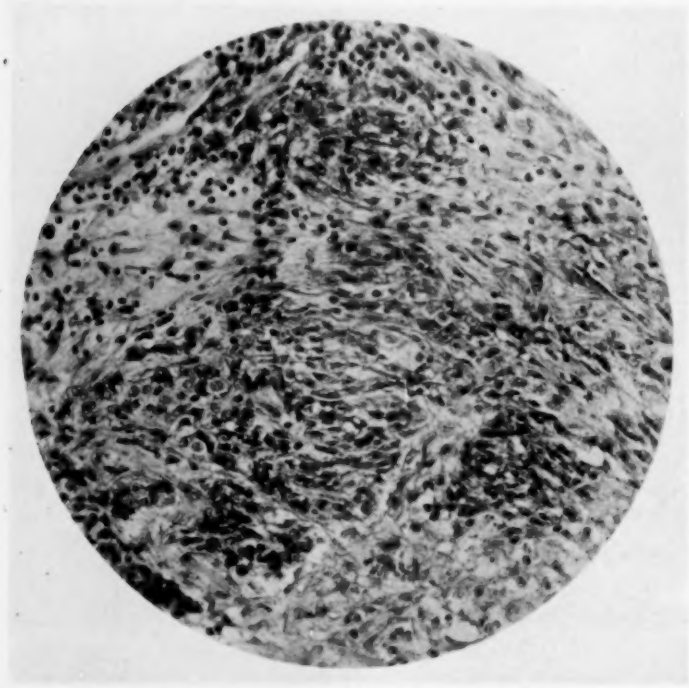


FIG. 6.—Metastatic lymphosarcoma of the axilla following a primary lymphosarcoma of the small intestine seven years before.

On July 23, 1918, he again came East; at this time only a very small, hardly-perceptible mass could be felt at the site of the original tumor. As a precaution he was given a radium-pack treatment of 10,000 mc. hours at 7 cm. distance; this was repeated. The toxins were continued. He received further treatment with radium pack in 1919. The toxins were kept up by his local physician; two or three injections a week were given, in doses not sufficiently large to interfere with his daily routine of life. He came East again in May, 1920, at which time, physical examination failed to reveal any definite mass in the abdomen; there were, however, two very small glands in both cervical regions. The lead tray, containing 3000 mc. hours of radium, was applied at 3 cm. to each area; and 17,000 mc. hours in the form of a pack were applied over the abdomen. November 25, 1920, he received a pack treatment (6344 mc. hours) over the abdomen. The toxins were continued, and he had no further radium until June 8, 1921, when the lead tray containing 2070 mc. hours was applied to the left supraclavicular region, and 6344 mc. hours in the form of a pack, were applied to the abdomen. In January, 1922, a small nodule was noticed on the left elbow; this was treated with the X-rays and disappeared. In January, 1923, he received another pack treatment, 18,026 mc. hours at 10 cm. distance, over the abdomen. The toxins were kept up until November, 1923, by which time the patient had become tired of taking them, and discontinued all treatment. About two months later he noticed slight enlargement of the glands of the left axilla; these have steadily increased in

size. The patient next came under the reporter's personal observation January 20, 1925. At this time there was detectible enlargement at the site of the old intra-abdominal tumor, which apparently involved the retroperitoneal glands, as the mass seemed more or less fixed; the cervical and inguinal glands were normal. In the left axilla was a mass about the size of a large goose-egg or a small orange, soft in consistence, movable, and extending for some distance beneath the edge of the pectoral muscle. January 22, 1925, there was given to him his last radium treatment: 12,000 over the abdomen at 10 cm. distance; January 24, he received 10,000 mc. hours at 10 cm. over the left pectoral region, and January 26, he received 10,000 mc. hours at 6 cm. over the left axilla. February 4, at the Hospital for Ruptured and Crippled, the tumor under the arm was removed surgically. Microscopically (Fig. 6) this proved to be a typical lymphosarcoma.

This case is especially worthy of note for the following reasons: In the first place, it shows that a rapidly growing lymphosarcoma of the small intestine has been almost completely controlled for a period of more than seven years and the patient has remained in excellent health during the entire period; in the second place, it shows that even when metastases have developed, one should not abandon treatment. In this case, the first metastasis in the cervical glands occurred nearly five years ago; under further treatment, complete disappearance took place and there has been no recurrence. The latest and most extensive metastasis, in the axilla, did not occur until November, 1923, some time after the toxins had been discontinued.

Dr. John Douglas referred to a case the specimen of which he showed before this Society three years ago, of a man he operated on for lymphosarcoma of the small intestine five years previously, in which there was apparent involvement of the mesenteric glands and a bad prognosis given. That man is alive and well to-day, eight years after operation, and has had no recurrence of any kind. In that case, resection was done of about sixteen inches of the intestine.

Doctor Coley remarked that he believed in the case presented, the disease, in all probability, will prove fatal in the end; but that if the treatment with toxins and radium were kept up, in his opinion there was ground for believing that the patient would live several years more.

In answer to a question as to which agent was responsible for the result in this case, Doctor Coley replied that when two methods of treatment were carried out in the same case it was impossible to decide definitely which one was responsible for the improvement or cure. During the last ten years, at the Memorial Hospital and other places, a very large number of cases of lymphosarcoma had been treated with X-rays and radium; so far he knew of no case that had remained in good condition for so long a period as the present case. While these tumors as a rule show very great improvement under radium and X-rays, in many instances amounting to complete disappearance of the tumor, the improvement has proved only temporary and a recurrence has taken place in a few months to a year or two. A summary of this personal case of primary neoplasms of the lymphatic glands including Hodgkin's disease, shows 26 patients treated with the mixed toxins to have remained well from 1 to 22 years; 19 patients have remained well from 3 to

22 years (statistics quoted from his paper on the subject published in the Transactions of the American Surgical Association for 1915).

CARCINOMA OF BREAST TEN YEARS AFTER SUCCESSFUL TREATMENT OF GIANT- AND SPINDLE-CELL SARCOMA OF FEMUR

DR. WILLIAM B. COLEY presented a young woman, twenty-one years of age, who had been shown at several previous meetings of the New York Surgical Society. A full report of her case will be found in the ANNALS OF SURGERY, December, 1919. She was admitted to the Hospital for Ruptured and Crippled in October, 1914, with a history of having had a swelling of the lower end of the femur for four or five months. The condition had been thought to be tuberculosis and a plaster splint had been applied. Exploratory operation on admission revealed complete destruction of the lower end of the femur with extensive invasion of the knee-joint. A specimen was removed, but no attempt was made to curette the tumor. A microscopical examination was made by Dr. F. M. Jeffries, pathologist to the Hospital for Ruptured and Crippled, who reported it to be a mixed-cell sarcoma. Dr. Francis Carter Wood called it a malignant giant- and spindle-cell sarcoma; and Dr. James Ewing reported as follows: "The tumor is not histologically benign; I merely mean it is not extremely malignant." Under one year's treatment with the mixed toxins of erysipelas and bacillus prodigiosus bacilliosus, the patient made a complete recovery; the sinus closed, and she has remained in good health for ten years. She is able to walk about without support of any kind, and a thick-soled shoe equalizes the two inches of shortening and nature has produced fairly good condyles as shown by X-ray picture taken five years later.

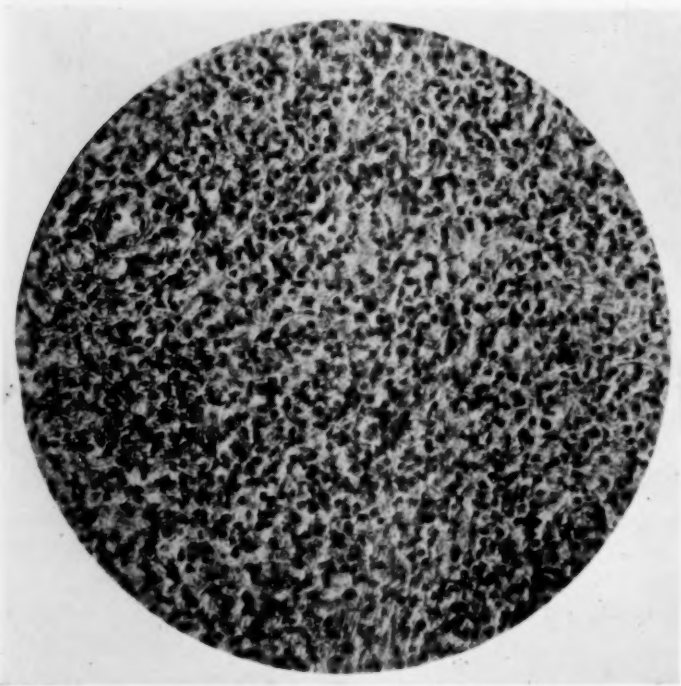


FIG. 7.—Malignant tumor of the breast in a patient twenty-seven years of age, occurring ten years after complete recovery from a giant- and spindle-cell sarcoma of the femur involving the knee-joint treated by mixed toxins (limb saved).

About one year ago, a tumor appeared in the right breast, which, clinically, was diagnosed as fibro-adenoma; this was confirmed by microscopical examination. In April, 1924, she had a slight trauma of the right breast. In June of 1924, she developed another tumor in the same breast at the site of the

old scar. This grew somewhat more rapidly than the previous one, and about three months later, a small nodule, about the size of a small cherry, appeared one inch above the main tumor and separate from it. The larger tumor was soft in consistence, apparently cystic, and resembled a cystadenoma. In the latter part of October, 1924, the reporter removed the entire breast surgically. Macroscopically, both tumors appeared to be malignant and on account of the lack of induration, the rapid growth, and the early age of the patient, he was inclined to believe the condition to be one of sarcoma rather than carcinoma. Doctor Jeffries made a microscopical examination (Fig. 7); he stated it was a malignant tumor, but whether it was sarcoma or carcinoma he was unable to decide; after further and more careful examination of a large number of sections, he came to the conclusion that it was a sarcoma. Doctor Ewing also expressed the same doubt as to whether it was a sarcoma or carcinoma; but after making a number of slides at his own laboratory, he finally made a diagnosis of carcinoma. Doctor Wood, likewise, found difficulty in classifying the tumor until he had received some of the gross specimen and made a number of special stains at his own laboratory; after a careful study of these, he pronounced it definitely a cellular carcinoma.

In this case, the problem is to decide whether one is dealing with a secondary metastatic sarcoma of the breast or a primary carcinoma. The weight of evidence forced him to conclude that it was a carcinoma, a condition independent of the original sarcoma of the femur of ten years before. While it is extremely rare to find two different types of tumor occurring in the same individual, there are a number of such cases on record. Some years ago he reported a case of recurrent carcinoma of the breast, during the progress of which a small round-cell sarcoma developed in the submaxillary gland; the disease ran an extremely rapid course, proving fatal in a few months. He had one other case, a primary sarcoma of the uterus, in which, several years later, an adenoma developed in the breast and a rapidly progressing carcinoma in the right breast which resulted fatally in spite of operation.

GALL-BLADDER AND GALL-DUCT SURGERY

Dr. Frank S. Mathews read a paper with the above title, for which see p. 961, Annals of Surgery, vol. lxxxi.

Dr. John F. Erdmann said that in reference to the absence of definite signs, he personally relied on the X-ray only if it presents a shadow of a stone. Even the laity at the present time are satisfied that the X-ray, as far as the gall-bladder is concerned, may be a negative factor. As regards the question of typhoid complication or stones following typhoid, years ago it was believed that of the patients who had gall-stones, twenty to twenty-five per cent. were due to typhoid or gave a history of having had typhoid. Personally he believed that other types of infective organisms were also productive of stones. He recently operated on a woman who three weeks after typhoid got up an acute cholecystitis. That subsided and she went along for three weeks with normal temperature. But one night the temperature rose to 104° with quite an increase in polymorphonuclears. He then advised operation, suspecting stones or cholangitis. Operation was performed on the night of the third day following, at which time she was deeply jaundiced and revealed a dilatation of the common duct. An œdematous gall-bladder was found and removed. When the dilated common duct was opened there was

an outpouring of bile and purulent material. Smears presented the bacillus typhosus. This woman is still discharging typhoid bacilli, although her gall-bladder was removed. With reference to complicating duodenal ulcers, Doctor Erdmann said his experience had been practically the same as that of Doctor Mathews. They give a history of intense pain such as one would get with perforation and symptoms of definite duodenal ulcer. He has had a series of these cases which have perforated into the transverse colon, duodenum and stomach. He merely does a plastic repair of the perforation and they get along without difficulty. In regard to drainage after operation. He has drained and he has not drained for twenty-five years. He did not drain the cases of not markedly infected gall-bladder resections eighteen or twenty years ago until he had a leakage in a case and then he resorted to the drain again for a series and then again ceased draining until a third leakage occurred. Now for three years he has not drained and still does not believe in draining gall-bladder cases unless there is profound infection. In regard to acute cholecystitis, he did not believe there was justification in letting one subside before operation. The mortality is not increased thereby, but believes it is lower than in the waiting to cool off policy. He never hesitates to take a gall-bladder out in the acute stage. In regard to the mortality, the cholecystectomies present one-half of one per cent. less as compared with cholecystostomies. He finds this about the same in the reports of all the larger clinics. In regard to jaundice in these cases, he used chloride of lime; it increases the coagulability of the blood. Any patient with a blood coagulability over seven minutes by capillary method is given lime. He gives 10 to 30 c.c. of a ten per cent. solution in several days and if there is no diminution in time of coagulability, then the patient is transfused. A school teacher came to him with marked purpura and coagulation time of thirteen minutes. She got one dose of lime and began to react and wanted food. The pain and temperature subsided and in two and a half weeks she was well with coagulation time of four and a half minutes. Three weeks later she had a chill and temperature and jaundice and at operation a small gall-bladder was found with recent fistula into the intestine. He did not think that the coagulation time had anything to do with the small amount of lime used, but that the evacuation of the bile through the perforation was the cause of her diminished coagulation time as it allowed a free drainage.

In regard to danger to the common duct, no one can gainsay it. There are times when one will cut into it. The best method of operation is the lateral incision, rotating the gall-bladder toward the median line. Injuries to the common duct are not due entirely to the forceps grasping the whole duct, but to the manner of grasping the duct with the forceps and traumatizing it so there is a slough following. Outside of the incidence of malignancy, the speaker's indications for operation were the prevention of pain, prevention of abscess, prevention of gangrene, and to-day people are willing to undergo operation merely for the prevention of pain.

Dr. Walton Martin emphasized the dicta, first, that even if there were

but slight evidences of morbid changes in the gall-bladder, it was wise to remove the gall-bladder when there was an "unimpeachable history indicating gall-bladder trouble." Second, that the removal of several structures in the hope that one of them might be responsible for a symptom complex was not conducive to the advancement of the knowledge of the surgeon and of very doubtful benefit to the patient.

Doctor Martin had found it easier to remove the gall-bladder beginning at the ampulla. He did not believe that there was danger in this procedure if the cystic duct was accurately identified before ligation. Moreover, he had found the cicatrix stronger if the incision passed, not in the outer border of the rectus, but at the junction of the middle and inner third.

He reported an instance where severe hemorrhages from the bowel and stomach were the outstanding symptoms in a patient in whom a large stone was making its way through a gall-bladder adherent to the duodenum.

Doctor John Douglas said as to the history of typhoid in its relation to gall-stones, he agreed as to its probable lack of importance in diagnosis in most cases, but as an instance of where the exception proved the rule, he had operated on a patient last summer at Bellevue who had developed an acute cholecystitis with jaundice while convalescing from typhoid and had an inflamed gall-bladder full of freshly formed small stones which cultured typhoid bacillus and the stones appeared as if they had been recently formed.

As to postponing operation in acute cases, the speaker believed it worth while to postpone operation where the patient is decidedly sick or deeply jaundiced, and it will be of assistance to get the blood chemistry coagulation time and other clinical data which will be of assistance in handling the case at the time of, or after operation. But to delay merely because it is an acute case is unnecessary. The last case in which operation had been delayed to allow an acute gall-bladder lesion to "cool off" before he had seen the patient, turned out to be a perforated duodenal ulcer with abscess.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held March 2, 1925

The President, Dr. Edward B. Hodge, in the Chair

FRACTURE OF FIBULA WITH SEPARATION OF LOWER TIBIAL EPIPHYSIS

Dr. Hubley R. Owen presented a boy who, September last, fell and injured his left ankle. A plaster case was applied by his family physician and left without removal for two months. When it was taken off a marked deformity was apparent, for the relief of which he applied to the Orthopædic Hospital, where he came under Doctor Owen's care. By an osteotomy a good alignment was secured with good joint function. He was surprised to find how difficult it was to cut through the epiphysis.

Dr. A. P. C. Ashhurst said that of 300 cases of ankle fracture studied by him some years ago there was but one found of the type described by Doctor Owen. He had had another case recently.

FRACTURE OF A BONE GRAFT

Dr. George P. Muller remarked that the problem of bone regeneration has been the source of much discussion for over fifty years and even now is open to further study. Ollier, in 1867, announced that the transplantation of living autogenous periosteum-covered bone would result in a living transplant and he considered the periosteum as the most important factor in maintaining the life of the transplanted bone. Barth, in 1893, reported the results of some experiments which showed that the bone transplant dies and only acts as a sort of scaffold to be gradually replaced by new bone formed from the surrounding bony tissue or fragment ends. This was also the opinion of J. B. Murphy (1913). As a result of this opinion surgeons began using boiled bones as transplants. In 1902, Axhausen stated that while much of the transplanted bony tissue died, a few cells persisted *in the periosteum* which survived and produced the new bone. In 1912, MacEwen claimed that the periosteum is merely a limiting membrane, and that all osteogenetic activity resides in the bone cells. His theory has attained rather wide acceptance, notably by Gallie (1918).

Mayer and Wehner (1914), Phemister (1914) and a number of other writers now believe that there are specific osteoplastic cells, probably in all of the elements of the transplant, which persists and regenerate new bone by a process of absorption and substitution. The graft receives nutrition both from serous permeation and an ingrowth of capillaries from the surrounding tissues. He had been attracted by the statement of Mayer (Annals of

SURGERY, 1919, vol. lxix, p. 360) when he says: "Neither the scaffolding theory, nor the opposing view is entirely correct, but a double process is at work; to a certain extent the graft acts as a scaffold for the ingrowth of osteoblasts derived from the adjacent bone, but it also contributes to its own life, first by the persistence of bone cells, second by the activity of the transplanted periosteum."

In one of his papers, Phemister (1914) reports on the results of five experiments in which a long transplant was fractured in the middle. In three specimens the periosteum was removed and in two others it was left on. When periosteum was left on there was callus formation at the seat of fracture in the transplant which underwent ossification before that which united the fractures at the ends. In one case there was bony union in forty-five days, while the two fractures at the ends were freely movable. On the other hand, where periosteum was removed, union was by a fibrous intermediary callus which showed only a small amount of ossification at the end of eighty-seven days.

He concluded that "a fracture through a transplant unites by callus formed from the surviving cells of the transplant in the vicinity of the fracture." The speaker thought it worth while to report the following case, particularly as he was able to observe the course of events over a long period of time.

DOCTOR MULLER then presented a young woman, twenty-two years of age, who was admitted to the University Hospital, January 28, 1921, on account of a slowly growing tumor at the upper third of left tibia. No trauma. Duration five years. Pain past three weeks. The growth involved the entire circumference of the tibia, without "crackling" of cortex. X-ray (Fig. 1) showed this to be a bone cyst or enchondroma (Baetjer) or giant-cell sarcoma (Pancoast).

Operation.—(January 29.) Longitudinal incision. Cortex found exceedingly hard. Section of tibia isolated and six inches resected by Gigli saw. A bone graft 7½ inches long was removed from the right tibia with a sharp chisel and implanted into the wound with ends pushed into medullary cavity. The graft included periosteum as well as endosteum and cortex. Wounds closed without drainage. Plaster case applied. Graft in perfect position. (Fig. 3.) *Pathological Report.*—Benign bone cysts (obsteitis fibrosa cystica). (Fig. 2.)

Discharged February 17, 1921, on crutches. X-ray examinations were made at frequent intervals and about one-half of these are reproduced. About five months after the operation it will be noted (Fig. 4) that the graft is united at both ends and particularly at the upper. Bearing on this point is the statement of Gallie, "the transplants must be imbedded in the fragments for a considerable distance in order that the bone-forming qualities of the periosteal and endosteal surfaces of both transplants and fragments may be enlisted to make certain of solid bony union." There is evidence of new bone formation all along the graft, very faintly traced, however.

Early in September, 1921, the patient fractured the graft. A brace had been worn since July, but was immediately replaced by a plaster case. Callus began early at the seat of fracture and is perceptible by October

(Fig. 5), and better in November. (Fig. 6.) In April, 1922, the fracture was united but the bony union was apparently not perfect. (Fig. 7.) By this time the lower fragment as well as the upper had become pointed. The brace was resumed. In March, 1923 (Fig. 8), and January, 1924, the graft had perceptibly thickened and the callus at the seat of fracture had begun

FIG. 1.—X-ray appearance of cyst.
FIG. 2.—Drawing showing the nearly solid cyst after removal.
FIG. 3.—Appearance of the bone one week after introduction of graft (1-29-21.)
FIG. 4.—Five months after operation. Note the callus reaching from the host bone ends.
FIG. 5.—After fracture. Note suggestion of callus.

to disappear. The brace was discarded. In March, 1925, four years after the operation, the graft is nearly as thick as the lower part of the tibia, but has not blended as well with the upper fragment. (Fig. 10.) Note that the graft end is still visible in the upper end of the tibia.

The patient has ¼ inch shortening and walks without limp.

He adopted the medullary graft because it seemed as though there would be more immediate stability, although he was aware that generally speaking an inlay graft is more satisfactory theoretically and particularly

in the case of non-union after fracture. McWilliams (ANNALS OF SURGERY, 1921, vol. lxxiv, p. 286) believes that the intramedullary method of grafting should be discarded, and while Doctor Muller agreed with this argument in the matter of using the graft as an intramedullary peg in ununited fracture,

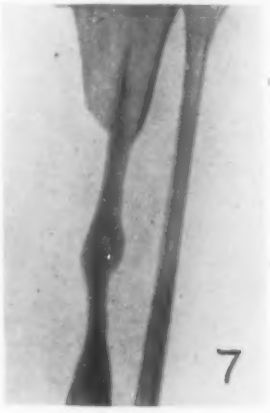


FIG. 6.—Three months after fracture. Note increase of callus, firm union of fragments to bone ends.
FIG. 7.—Fifteen months after operation. Note pointing of lower tibial fragment.
FIG. 8.—Two years after operation. Thickening of graft proceeds slowly. Callus less prominent than in previous years.
FIG. 9.—Three years after operation. Little evidence of the fracture. Graft larger than fibula.
FIG. 10.—Four years after operation (3-3-25). Except at the junction at the upper end, the graft appears as a normal tibia.

yet he thought the method has a use in long transplants such as the case herein reported.

Fracture of a bone graft has, no doubt, been noted by many surgeons, but there is little specific mention of the subject in the literature. In reporting a large series of cases from the Mayo Clinic, Henderson (*Jour. A. M. A.*, 1921, vol. lxxvii, p. 165) states that in a certain percentage the graft broke, usually about the fifth to the eighth week. He thinks that massive grafts

firmly held to the fragments with beef-bone screws afford greater safety against fracture. McWilliams (ANNALS OF SURGERY, 1921, vol. lxxiv, p. 286), in his collection of 1390 reported cases, found 17.6 per cent. of failure but only states that fracture or dislocation of the graft may be a cause of failure and are due to insufficient immobilization. Eloesser (*Archives of Surg.*, 1920, vol. i, p. 428) reported a series of twenty-two patients, personally operated on, and of these refracture occurred in seven. The graft always broke near the middle, the ends remaining firmly welded to the matrix bone. In two cases the refracture united, in one with considerable callus. Smith (*Jour. Orthoped. Surg.*, 1921, vol. iii, p. 270), in 1921, describes two varieties: (1) Disintegration fracture, occurring six to eight weeks after operation and resulting, as a rule, because absorption outstrips restitution; the graft becoming soft and porous at the ends, and if rigid, immobilization has not been carried out, the connection between graft and lost bones becomes loosened. He reports an example in the case of a bone graft for a defect in the upper third of the ulna, which reunited with a large amount of callus. (2) Clay-pipe stem fractures, occurring several months after the bone grafting, and which results because for a prolonged period the graft may depend almost entirely on its mineral constituents for its strength, especially at the centre. Smith thinks they unite, but a prolonged period of immobilization is necessary. It would seem as though the repair of the fractured graft reported in this paper was an evidence of persistence of the living graft, but Mamourian (*Brit. Med. J.*, 1921, vol. ii, p. 934) believes that the appearance of callus about the ends of a broken graft is not proof of the survival of the graft but only an evidence of greater local stimulation. But Haas (*Surg., Gyn. Obst.*, 1923, vol. xxxvi, p. 749) showed by experiment that there is an inherent power of regeneration in a transplanted piece of bone, even if the transplanted fractured graft was implanted into a muscle removed from any possibility of osseous ingrowth from other bones. If the graft was boiled and implanted no signs of bone proliferation occurred.

DR. DEFOREST P. WILLARD said that three or four years ago he saw at Toronto a number of the war cases which had been treated with bone graft bridging large defects in the tibia. A large series was shown; about 50 per cent. had had fracture of the bone graft, nearly always at the juncture of the middle and lower third of the graft. The upper new bone coming down had covered about two-thirds of the graft, but the bone from the bottom had been a little slower and the fracture had taken place at that position in the lower third and practically always at the end of seven months from the time the bone graft had been put in. They emphasized the need for extra support of the bone graft between the sixth and the eighth month because that is the dangerous time. They were especially careful during that period with their later cases and have had less trouble with the grafts.

DR. A. P. C. ASHHURST said that he had a bone graft fracture after eight years. It was a case of giant-cell tumor of the lower end of the radius. It is interesting on account of the question of the blood supply. The tumor

was at the lower end of the radius and he excised the lower third, including the joint surface, putting in a bone transplant shaped as nearly as possible like the lower end of the radius, and fastened it to the remaining shaft with a plate, screws and wires. This bone came in contact with other bone only at one end of the graft, the other end being free in the wrist-joint. At the end of eight years, the patient struck it against a table and the graft fractured about its middle. He kept the forearm in a plaster splint for a long time, but at the end of one year she still had non-union. He then operated on her again, nine years after the first operation, took out the plate and screws and cut a slot into the transplant across the line of fracture, with a circular saw, and inlaid in the original bone transplant another bone transplant and secured firm union within a few weeks. On examining specimens of bone removed from the fracture line, the bone was found to be dead, so far as the pathologist could tell; there were no live bone cells in it. The question now arises whether, if the circulation gets into the transplant only from the bone to which it is attached, how does it happen that the part of the bone not connected with other bone, but entering the wrist-joint, was living? The circulation must have come in from the periphery on all sides.

The longest transplant he had used was about 18 cm. long. He used this to supplant the upper half of a tibia which was being excavated by a parosteal sarcoma. He cut out the tibia from the knee-joint down; placed the remaining fibula in a hole in the external condyle of the femur, and took a transplant from the other tibia for the inner condyle; this was nearly ten years ago and the graft has not broken as yet. He sees no reason why the one graft should remain and the other fracture. Neither graft was an inlay graft: that in the forearm was in contact with bone only at its proximal end, while that in the leg was implanted at one end in the narrow cavity of the remaining tibia, and at the other in a hole drilled into the internal condyle of the femur. The periosteum was left intact on both transplants, so far as possible, since he regards it as a protective membrane and desirable whenever a transplant is to lie exposed to extraosseous tissues. When an inlay-transplant is used, he regards the periosteum as detrimental.

BONE GRAFT OF THE TIBIA FOLLOWING REMOVAL OF A GIANT-CELL TUMOR

Dr. Isidor S. Ravdin presented a negro girl, six years of age, who was admitted to the University Hospital, June 27, 1924, with the history that about eight months previously she had sustained a fracture of the lower end of the right tibia for which she was operated on. The leg never recovered its normal size and at a later operation the bone was "scraped." Following this there was a gradual enlargement at the ankle for which she was admitted at the University Hospital. Examination of the lower end of the right tibia showed a fusiform swelling of the lower third. The swelling was firm, prominent, tender and painful. There was present the scar of a previous operation. The X-ray diagnosis by Doctor Pancoast was giant-cell tumor. The cortex is intact except possibly a small area on the inner aspect of the tibia.

July 3, 1924, the patient was operated on by Dr. George P. Muller. A

tourniquet was applied. An incision was made over the lower end of the right tibia on its inner surface. The periosteum was opened and the tumor was dissected free from its periosteal enclosure. A Gigli saw was then passed around the tibia above the tumor and the bone was divided. The same procedure was practised on the lower end of the tibia after the epiphysis had been carefully dissected free from the growth. The cavity was then irrigated with McDonald's solution. The tourniquet was removed, bleeding points were caught and the wound closed with tier suture, without drainage.

July 26, under ether anæsthesia, Doctor Ravdin removed a graft about five inches long from the left fibula and inserted it into the medullary cavity of the right tibia. The entire circumference of the fibula on the left side was used, leaving only a small portion of the periosteum behind it. No attempt was made to fix the graft into the tibial epiphysis. The wound was closed without drainage. A plaster bandage was applied to both legs.

August 3—X-ray report: Right leg: The bone graft is in very good position in the tibia. The upper end of the bone graft is in the medullary canal of tibia. The lower end is located over the epiphysis of the tibia. Left leg: Negative, except the fibula shows absence of piece of bone used for bone graft in right leg.

August 19—X-ray report: There is no definite evidence of bone disease, but the distal end of the upper fragment of the tibia is slightly rarefied. The periosteum is forming new bone over the portion of the shaft that was excised.

November 10—X-ray report: Good regeneration of the tibia and fibula, but there is still inversion of the right foot.

Pathological report of the tumor removed: a benign giant-cell tumor.

The giant-cell tumor was formerly considered malignant, but has gradually been placed in the group of benign lesions. It is regarded by many surgeons and pathologists as a normal attempt at repair following traumatic or low-grade infectious processes. It is therefore called by some pathologists chronic hemorrhagic osteomyelitis.

Coley has reported a group of giant-cell tumors in which metastasis occurred. Stone and Ewing in their last paper, however, stress the fact that a true giant-cell tumor does not metastasize. The tumor may undergo malignant change, or the pathologist may fail to recognize the malignant character of the tumor primarily.

Henderson and Meyerding, of the Mayo Clinic, have used the fibula as an intermedullary bone graft in cases such as the one reported. Henderson believes that the approximation of endosteal with periosteal tissue does not offer the same chances of success as the direct approximation of cancellous or endosteal tissue. Furthermore, he does not believe that the intermedullary bone graft gives a sufficient margin of safety against fracture.

However, the reporter believes that if the periosteum can be saved, so that regeneration of new bone can take place from this, the results should be nearly as good as those obtained from the inlay graft.

Dr. George P. Muller said that in this case the questions of diagnosis and primary treatment were decided entirely by the X-ray. At the time of operation after he sawed through the tibia, he found the tumor with a shell about it which could be enucleated from the periosteum, so it was scooped out to the end of the epiphyseal line where it was detached with forceps. At the lower base of the cavity it came away by simple enucleation. The periosteum was left because in three or four cases where he had removed a large

portion of bone, as for osteomyelitis in children, and left the periosteum, there has been complete regeneration of the shaft. He had no definite intention of applying a bone graft in this case, but while he was away on vacation, Doctor Ravdin thought it best to do the graft, and it may be that the child is getting the result from both the original operation and the graft. Doctor Muller then exhibited a set of lantern slides from a man who had had fifteen operations for chronic osteomyelitis performed in various hospitals. The reporter himself removed a section of the tibia and did a Huntingdon operation by removing a portion of the fibula, shifting it together with the muscular tissue, and jamming it into the tibia at either end. The patient developed infection, necessitating the use of drainage, but as the new slides show, thirty months after operation, there was practically a new tibia. It is generally known that the fibula when transplanted will enlarge rapidly and take the place of the new bone, and this case shows better bone formation than in the case reported by him in which the graft was done.

PROSTATIC ABSCESS

Dr. Leon Herman read a paper with the above title, for which see p. 1115.

Dr. Alexander Randall commented upon the remarkable diversity of pictures which these cases of prostatic abscess show. The literature contains some unique examples, such as the interesting case of Lydston, where it was clinically thought to be an hypertrophied prostate, and even at supra-pubic cystotomy it was unsuspected and spontaneous rupture took place during the period of bladder drainage; or that of Harlow Brooks, which clinically so simulated enteric fever, that for four weeks the true condition was completely masked. He himself had seen a case in which for three weeks it gave every symptom suggestive of malaria except the absence of the plasmodia and then only incision for a prostatectomy uncovered the true condition. Doctor Herman has accentuated three things of the greatest importance: First, that a great many of these cases are non-specific in their origin and due to infective organisms. In a short series, which he reported six years ago, of sixteen cases, exactly one-half were proven to be non-Neisserian infections. The second point which he brought out possibly too lightly, is the question of the leucocyte count. It is of the utmost value and is frequently exceedingly high. And the third point which must be continually accentuated is the proper mode for treating these cases. The old practice of rupturing an abscess on a sound in the urethra is an operation so blind, hemorrhagic, destructive and particularly mutilating, that he did not hesitate to call it absolutely unsurgical. The post-operative morbidity in these cases is frequently hideous and many of them are made prostatic cripples for the remainder of their lives. Drainage by rectal puncture is equally unsurgical, and because of the likelihood of urethral rectal fistula, should never even be considered.

A perineal extra-urethral incision is the method of choice. With clean-cut surgical approach, pendant and copious drainage without damage to the

urethra or rectum, it gives man a promise of a complete resolution and repair. There is no method to be considered other than this.

Dr. Damon Pfeiffer detailed the history of two cases from his experience, one about three years ago; a man who was seized while on a trip to Washington, with very severe pain in the perineum and great difficulty in urination. He came back home and soon observed a slight urethral discharge and then an epididymitis. He absolutely denied venereals. A few days later, he discharged a large amount of pus from the urethra and went on to recovery. The culture showed staphylococcus aureus.

Recently he saw a case of abscess of the prostate which had existed at least five weeks before it was recognized. The man was being treated for continued fever without diagnosis. On rectal examination a large fluctuating mass was found in the region of the right lobe of the prostate which was opened without difficulty.

Doctor Herman (closing discussion on his paper) described a case recently met with in an old man presenting all of the cardinal symptoms of benign prostatic enlargement. This individual had a leucocyte count of 36,000 in the absence of fever. Following supra-pubic drainage large quantities of pus came through the tube, which in all probability was due to a chronic abscess of the prostate which had ruptured spontaneously into the bladder.

All of the cases in the series reported by him, with one exception, had gross prostatic pus varying in amount from one-half drachm to one quart. The exception referred to was a man in whom, while there was a leucocyte count of 18,000 present and the temperature of 100, no gross abscess was found at operation.

POST-OPERATIVE COMPLICATIONS

Dr. J. Bernhard Mencke read a paper with the above title, for which see p. 1160.

BOOK REVIEWS

HANDBOOK ON OPERATIVE SURGERY. By SIR WILLIAM IRELAND DE C. WHEELER, Fourth Edition. New York, William Wood and Company, 1925.

This single volume of 441 pages containing 298 illustrations is a work published essentially for the use of students and internes. While no single volume of surgery can be complete in all details, this particular book is very comprehensive in its scope. The commoner operative procedures are taken up in considerable detail; no space being allotted to symptomatology and diagnosis. Reference is made to the various forms of local anæsthesia and a description of the oil-ether colonic anæsthesia as devised by Dr. Alfred Boyd has been introduced. There are many points discussed which are not in accordance with the present-day orthodox technic such as the anastomosis of the vas deferens by means of a needle introduced into the lumen. The rubber glove method of establishing air-tight drainage of the chest is fully considered. The drawings are well done and comprehensive. There are a few X-ray photographs dealing with the subject of arthroplasty in relation to the discussion on ankylosis. As a rule there is only one operative procedure given for the disease under discussion. There are, however, some instances in which several methods are described.

In spite of the fact that this book will be of little value to the operating surgeon, many uses will be found for it in the hands of the younger man whose "thoughts and fancies are not confined to the realms of surgery." For these people the reviewer considers the book well done and very definitely needed. For them it is most highly recommended.

MERRILL N. FOOTE.

ON THE BREAST. By DUNCAN C. L. FITZWILLIAMS, F.R.C.S. Surgeon in charge of out-patients and lecturer on operative surgery to St. Mary's Hospital, London. C. V. Mosby Company, St. Louis, 1924.

This single volume of four hundred and forty pages, very profusely illustrated by pen and ink drawings, with occasional plates of microscopic sections, is well bound and is printed with clear type on good quality paper. There are twenty-seven chapters, each one of which considers, in detail, some particular disease or condition relative to the human breast. The first chapter deals with the development. The second devotes twelve pages to the consideration of the anatomy. There is a chapter on abnormalities and one on anomalies which contains many interesting sketches. The acute infections are next discussed. There is a very instructive chapter on the so-called hysterical breast. There are eight chapters dealing with the various aspects of breast malignancy. The last chapter is written by Dr. G. H. Orten and deals with the X-ray treatment of malignant disease of this organ.

While this work offers little or nothing new as far as diagnosis and treatment are concerned, it accomplishes one very important function in that it groups together in one volume, all of the various pathological conditions of the breast and gives in concise form the accepted treatment thereof. We notice throughout that the work abounds in clear thought, keen observation and incisive expression, all of which are so very characteristic of the English clinician. The reviewer feels that works of this sort are of great value to the medical profession. As a text-book it is too comprehensive, but as a reference book it should fill a much-needed want not only to the surgeon, but to the internist and general practitioner as well. "In its own way this book of Fitzwilliams' serves to furnish us clear-cut clinical pictures and to fix them in our minds by cleverly condensed accounts of the essential embryologic, pathologic and anatomic facts."

MERRILL N. FOOTE.

CANCER DE L'UTERUS. Par JEAN LOUIS FAURE. Professeur de Chirurgie Gynecologique a la Faculte de Medecine de Paris. 8vo, 228 pages. Gaston Doin, Paris, 1925.

This is a treatise on a subject in which the method of treatment is still under discussion. According to Faure, there are more cures of cancer of the uterus by surgery than by radium, and the former antedate the latter by a considerable length of time. The section on pathology is excellent, especially as to the manner of extension outwards of the disease and the illustrations here are exceedingly good. He emphasizes the tardy appearance of the symptoms of this condition which are only seen when the local process is well advanced and enlarges on the fact that pain is absent in the beginning.

The section on treatment is the most important in this book. Faure says that it should be surgical when the uterus is movable and that radium should be used in the non-operable cases. He goes into great detail in giving the technic of radium treatment. He mentions the use of radium in order to reduce hemorrhage in the non-operable cases and says that he has seen a few inoperable cases made operable by the use of radium.

The description of the operative technic, as perfected by the author, is excellent and accompanied by a mass of very good illustrations and diagrams. This description includes abdominal panhysterectomy and his so-called vaginoperineal operation. He is an ardent supporter of the Mikulicz tampon.

J. PIERRE HOGUET.

THE LIFE OF SIR WILLIAM OSLER. By HARVEY CUSHING. In two volumes, large octavo; pp. 685 and 728, 1925. Oxford University Press, London and New York.

The scene of this life begins in a primitive parsonage in a pioneer settlement in an isolated district of the upper Canadian Wilds in 1849. It ends seventy years later in the midst of all the traditions and glorious survivals and multiplied honors of a royal professorship in the most ancient and aristocratic seat of learning in Great Britain. The chief elements of the greeting given

to this backwoods baby, the ninth child in the family, were love and hope; his baptism was into a spirit of joy and helpfulness that he carried with him during all the succeeding years of his long life, which made him a blessing to countless numbers of his fellowmen. How fortunate for the world it was that the preaching of the new faith of "Birth Control" had not reached the wilds of Canada in that rude age: we are lost in admiration of the pluck and devotion and courage which made the mother willing to abandon all the privileges of her English home and, cleaving only to her husband, accompany him to his mission field in such an unattractive spot, there, not only to be the lady bountiful of his extensive and wild parish, the friend of the poor and the consoler of the distressed, but bravely to endure the cares of frequent maternity, and last of all to bring into the world this black-haired, dark-skinned baby to whom the name of William was given. Surely in after years she too had her reward. For a time Death seemed to have forgotten her; all the changes of decade after decade went on about her; prosperity and honor attended her; the love of children, and grandchildren and great grandchildren surrounded her, and it was not until her years had reached a full one hundred that she calmly ceased to live. Truly she was of the material from whom great men are born!

From time to time in all classes of human endeavor, there appear men of especially brilliant qualities, who develop personalities that profoundly influence their age. Whence their origin, reason is dumb! They do not seem to be accounted for by any of the recognized tenets of heredity—certainly environment cannot be chargeable with their development, although environment often provides the occasion for the display of their qualities. In this group of men *William Osler* unquestionably belongs. In these volumes, which depict his life from the cradle to the grave, his pupil and friend, Doctor Cushing, has, with rare skill and fidelity, shown us Osler as he was, as he grew, as he matured, as he wrought in the full fruition of his powers. It is almost an autobiography that is presented to us, for the idea of the work is to let Osler tell his own story through his own letters into which he was continually throwing accounts of nearly every emotion and thought as he sent them in an endless stream to his friends everywhere. So we have him telling about himself, at Montreal, at Philadelphia, at Baltimore, at Oxford. We know what his ambitions were and how he went about to realize them. As to disappointments, he does not seem to have had any, until the final overwhelming calamity that brought his bowed head in sorrow to the grave. A certain boyish and whimsical spirit never failed him, ever ready to bubble over. He was the typical hero worshipper but his heroes were the saints of his own profession. One reads with interest his frequent references to the man who was helpful in directing his first attempts at original investigation into the field of natural science, who ever remained first in the category of his medical saints. His devotion to the merits of *Sir Thomas Browne* was again most characteristic of him, a devotion which saw in its object qualities which were most exalted, to realize which requires that the reader should share in

the mind of the devotee himself. All the exaltation and supersensitiveness and blindness of a lover in the height of his paroxysms of love for the object of a faithful affection are displayed in this cult. We cannot help but admire it, as a most attractive quality of this genial man.

Out of this hero worship springs his bibliophyllic spirit which made him the friend of librarians and booksellers the world over. Aside from this, one sees in these pages a man with an insatiable but unobtrusive appetite for helpfulness which made him the prince of friends and benefactors. In the pursuit of any object upon which he set his mind he ever displayed indefatigable energy directed by wisdom and tact that was quick to remove all difficulties. In his own special subject, the conditions of the human body in health and in disease, he was master, and in every life condition that was related to this prime subject he was interested. He could teach, he could investigate, and what was better he could stimulate others to investigate. He was a skillful physician, a great scholar, an interested and deep research student, a wise practitioner, an inspiring teacher, the creator of a new atmosphere in medical literature, a promoter of organized medicine in societies and journals, a sympathetic friend and prudent adviser, especially to the young.

Cushing mentioning an address by Osler on "*Creators, Transmuters and Transmitters,*" says that another class might have been added to advantage, *viz.*, that of "*inspirers or animators*" to which Osler himself belonged. To this class indeed we think that Osler does preëminently belong. His part in our medical life has been that of an intellectual ferment, the results of which appear not only in his own work and in that of others now, but will go on silently but effectually working indefinitely.

LEWIS S. PILCHER.

CORRESPONDENCE

TRANSPLANTATION OF EXTROVERTED BLADDER INTO THE RECTUM

EDITOR ANNALS OF SURGERY:

Sir:

In the ANNALS OF SURGERY, 1906, vol. xliii, p. 237, I recorded a case of extroversion of the bladder, in which, for the first time, the whole bladder was transplanted into the rectum. I first saw the patient on March 11, 1905.

Recently I showed the patient at a meeting of the Leeds and West Riding Medico-Chirurgical Society. He is in perfect health. All urine is passed by the rectum, and is evacuated about six to eight times in the twenty-four hours.

I have performed the operation upon four other cases: all have recovered, and are still alive in good health; all pass urine by the rectum at intervals of from three to eight hours. In none has there been any suspicion of an ascending infection of the kidneys.

BERKELEY MOYNIHAN, M.D.,
Leeds, England.

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INDEX TO VOLUME LXXXI

A

Abdominal Aorta, Ligation of the, 453.

Abdominal Operations, Post-operative complications of, 326.

Abdominal Situs Inversus Totalis, complicated by Ileocæcal Tuberculosis producing Acute Intestinal Obstruction, 507.

Abdomen, Surgical Emergencies of the, 917.

Abscess, Amœbic, of Liver, 1023; Lumbar, Chronic Post-cæcal Suppurative Appendicitis Causing, 1049; Metastatic, of Liver, 1030; of the Prostate, 1115, 1206.

Actinomycosis, Pelvic, 343; of the Tongue, 881.

Adenocarcinoma of the Nasal Passages, 1040.

Adhesions of the Ileum, the Result of Appendicitis, 563.

ALEXANDER, JOHN: New Thoracoplastic Procedure for Pulmonary Tuberculosis to Lessen Incidence of Post-operative Pneumonia, 748.

Amœbic Abscess of Liver, 1023.

Amputations in Industrial Surgery, 164.

Anæsthesia, Local, The Elimination of Morphin and Other Drugs, in Operations under, 994; Spinal, 38.

Anastomosis, Aseptic End-to-End Intestinal, 646.

ANDERSON, J. GORDON: The Elimination of Morphin and Other Accessory Drugs in Operations under Local Anæsthesia, 994.

ANDRUS, WILLIAM DEWITT: The Experimental Transplantation of the Diaphragm as an Adjunct in the Treatment of Lesions at the Lower End of the Œsophagus, 273; the Surgical Treatment of Angina Pectoris, 591.

Aneurism, Femoral Arteriovenous, 551; of the Renal Artery, 105; Traumatic, Treated by Excision and End-to-End Arterial Suture, 1150.

Angiitis, Thrombo, Obliterans, A Contribution to the Study of, 976.

Angina, Ludwig's, 704.

Angina Pectoris, Cervical Sympathectomy for, 585; the Surgical Treatment of, 591.

Ankle Fracture, Rare Form of, 1199.

Ankle-joint, Left, Complete Posterior Dislocation of, 881.

ANNALS OF SURGERY, Early Days of the, 1; Masters of Surgery in the Early Years of the ANNALS OF SURGERY, 3; Story of the, 392.

Anuria following Transfusion, 733.

Anus, Vaginal, 723.

Aorta, Abdominal, Ligation of the, 453.

AOYAMA, TETSUZO, Kidney Gummata, 495; on the Resection of the Stomach by Kocher's Method, 125.

Aponeurosis of the Internal Oblique Muscle, The Suture of the, to the Ligament of Poupart for the Cure of Inguinal Hernia, 833.

Appendicitis, Chronic Post-cæcal Suppurative, Causing Lumbar Abscess, 1049; with Gas Bacillus Infection, 1178; Hernia following the Use of the McBurney Incision in Operations for, 525.

Appendix, Mucous Membrane Polyp of the, 522; the Relation of the, to the Right Kidney and Ureter, 518.

Appendix Vermiformis, Polyposis of the, with Intussusception of the Appendix, 1002.

Arterial Suture after Excision of Traumatic Aneurism, 1150.

Arthritis Deformans of Hip-joint, Operative Treatment of, 1108.

Arthrotomy, Medio-lateral, for Knee-joint Disturbance, 1017.

Arteriovenous Aneurism, Femoral, 551.

Arteriovenous Fistula, Congenital, of Left Brachial Artery and Vein with Secondary Arterial Blood Supply to the Arm, 461.

Artery, Renal, Aneurism of the, 105.

Ascites, Extreme, from Portal Cirrhosis Cured by Combined Splenectomy and Omentopexy, 706.

ASHHURST, ASTLEY P. C.: Adenocarcinoma of the Nasal Passages, 1040; Cholecystectomy and Cholecystostomy, 878; Removal of Screws and Plates after Insertion in Bone, 528.

Atrophy, Acute Yellow, of Liver, 1018.

AUCHINCLOSS, HUGH: Carcinoma of the Breast, Illustrating the uncertainty of Prognosis, 552; Fascial Strip Repair of Femoral Hernia, 1009.

B

BABCOCK, W. WAYNE: Traumatic Aneurism Treated by Excision and End-to-End Arterial Suture, 1150.

BALDWIN, JAMES H.: Rupture of the Spleen, following Slight Trauma or Exertion, 729.

BANCROFT, FREDERIC W.: Anuria following Transfusion, 733.

BARLOW, R. A.: Actinomycosis of the Tongue, 881.

BASTIANELLI, RAFFAELE: Pylorus Spasm and Its Surgical Treatment, 45.

BEER, EDWIN, Incision for Radical Amputation of Breast Permitting Closure of Extensive Defects, 560; Appendicitis with Gas Bacillus Infection, 1178; Splenectomy for Purpura Hemorrhagica, 1178; Perineal Urinary Fistulæ, 1182; Kidney Abscesses with Gangrenous Cholecystitis, 1183.

BELL, H. GLENN: The Experimental Transplantation of the Diaphragm as an Adjunct in the Treatment of Lesions at the Lower End of the Œsophagus, 273.

BELL, LEWIS BARCLAY: Drainage of the Thoracic Duct in Experimental Peritonitis, 911.

BERNHEIM, BERTRAM M.: Congenital Arteriovenous Fistula of Left Brachial Artery and Vein with Secondary Arterial Blood Supply to the Arm, 461; Bile Duct, Gangrene of Common, 548; Traumatic Rupture of, 720.

Biliary Colic, Latent Jaundice as a Symptom of, 108.

Biliary Fistula, Internal, 305.

BILLINGS, ARTHUR E.: Carcinoma of Lateral Aberrant Thyroid Tumor, 1039.

Bladder, Gall, and Ducts, Surgery of the, 961; Gall-stones and Diseases of the, 955.

Bladder, Urinary, Extroverted, Transplantation of, into Rectum, 1212; Rupture of the, 1007.

Blood Disorders, Splenic, 906.

Bone-graft Fracture, 1199; After Removal of Giant-cell Tumor, 1204.

Bone Plates, Removal of, 528.

Bone, Semilunar, Kienboch's Disease of the, 857.

Bone Tumors, 1074.

Bowel Obstruction Caused by Gall-stone Fecolith, 1184.

BOYKIN, IRVINE M.: Repair of Nasal Defect by Italian Method, 1044.

Brachial Plexus, Gunshot Injury to the, 719.

Brain, Method for Exposing Anterior Portion of the Frontal Lobes of the, 1053; Some Surgical Aspects of the Pathology of Gliomas of the, 893.

BRAMS, WILLIAM A.: Final Results of Operative Treatment of Gastric Ulcer, 1102.

Breast, Carcinoma of the, Illustrating Uncertainty of Prognosis, 552; Postoperative; Lymph-node Stationary for Many Years, 700; Ten Years after Cure of Femur Sarcoma, 1195.

Breast, Diseases of the, Edited by Willmott H. Evans, Review of, 891; Incision for Radical Amputation of, Permitting Closure of Extensive Defects, 560; Late Recurrence of Carcinoma of, after Extirpation, 551; Plastic for Hypertrophy of, 874; Treatise on, by Duncan C. L. Fitzwilliams, Review of, 1208.

BRICKNER, WALTER M.: Fellow Worker's Appreciation of Two Scores of Years of Editorial Work, 410; Pelvic Actinomycosis, 343.

BROWN, HENRY P., JR.: Acute Intussusception in Children, 637.

Buccal Cavity, Carcinoma of, 698.

BULL, PETER NICOLAY: So-called Idiopathic Dilatation of the Œsophagus, 59, 466.

BURDEN, VERNE G.: Internal Biliary Fistula, 305.

Burn, Severe Electric, Complicated by Tetanus, 542.

BURNS, J. GILLETTE: Aseptic End-to-End Anastomosis of the Intestine, 670; the Early Treatment of Superficial, 439.

BUSBY, B. FRANKLIN: Bilateral Congenital External Dislocation of Patella, 876.

C

Cæcostomy, Valvular, for Colitis, 873.

Cæcum, Carcinoma of the, with Intussusception of the Involved Bowel, 1028; Tuberculoma of the, 801.

Calamities, Fracture, and Their Management, 111.
Calculi, Unusual Urinary, 540.
Cancer de L'Uterus, Treatise on, by Jean Louis Faure, Review of, 1209.
Cancer of Rectum and Recto-sigmoid, 972;
Capsular Plication, Crucial, The Treatment of Chronic Recurrent Dislocation of the Shoulder by, 143.
Carcinoma of Buccal Cavity, 698; of Breast, Illustrating Uncertainty of Prognosis, 552; of the Breast, Late Recurrence of, after Extirpation, 551; Breast, Post-operative; Lymph-node Stationary for Many Years, 700; of the Cæcum with Intussusception of the Involved Bowel, 1028; of the Face with Plastic, 714; of Lateral Aberrant Thyroid Tumor, 1039; of the Mouth and Cheek, A Suggestion for the Relief for the Pain from, 490; of Œsophagus, Removal of, with Recovery, 693; of the Rectum, 1030; of the Tongue, 717; of Upper Œsophagus and Pharynx, 695.
Carcinomatous Prolapsed Rectum, Extraperitoneal Resection of; no Recurrence in Six Years, 703.
Carp, Jay: Prostatic Abscess, 1115.
Carpus, Fracture-dislocation of the, 871.
Carter, Ralph M.: Statistical Results of the Radiographic Study of Injuries about the Wrist-joint, 532.
Carter, Rupert F.: The Operative Treatment of Duodenal Ulcer with Special Reference to the Horsley Operation, 631.
Cave, Henry W.: Rupture of Jejunum (Due to Direct Blow to Anterior Abdominal Wall), 722; Vaginal Anus, 723.
Caylor, Harold D.: Sarcoma Associated with Ovarian Fibroma, 674.
Cervical Cord Glioma, irremovable; High-radiotherapy, 1008.
Cervical Spine, Unrecognized Fracture of the, with Late Cord Symptoms, 870.
Cervical Sympathectomy for Angina Pectoris, 585.
Cheek and Mouth, A Suggestion for the Relief for the Pain from Carcinoma of the, 490.
Cholecystectomy; External and Internal Cholecystostomy, 761, 878.
Cholecystitis, Gangrenous, with Kidney Abscesses, 1183.
Cholecystostomy, External and Internal; Cholecystectomy, 761 and 878.
Christensen, Frederik Carl: Bone Tumors, 1074.
Cirrhosis of the Liver, Omentopexy, 712; with Omentopexy and Splenectomy, 1024.
Clamp, The Tongue Depressor Gastro-enterostomy, 872.
Cleft Palate, 708; the Surgical Treatment of, 573.
Coley, William B.: Gall-stone Fecolith Causing Bowel Obstruction, 1185; Intestinal Lymphosarcoma Cured by Toxin and Radium, 1192; Breast Carcinoma Ten Years after Cure of Femur Sarcoma, 1195.
Colic, Biliary, Latent Jaundice as a Symptom of, 108.
Colitis, Valvular Cæcostomy for, 873.
Colon, Diverticulitis of the, 322.
Colp, Ralph: The Relation of the Submaxillary Salivary Gland to Infections of the Submaxillary Triangle of the Neck, 611.
Complications, Post-operative, 1160.
Connors, John Fox: Management of Intracranial Injuries with or without Fracture, 901.
Conwell, H. Earle: Complete Posterior Dislocation of Left Ankle-joint, 881.
Cottle, George F.: Surgery of Juxtapyloric Ulcer, 149.
Cox, H. Hoyt: Drainage of the Thoracic Duct in Experimental Peritonitis, 911.
Cranial Endothelioma, 1036.
Cranial Vault, Compound Depressed Fracture of, 1025.
Craniotomy under Local Anæsthesia, 213.
Crile, George W.: Post-operative Complications of Abdominal Operations, 326.
Cushing, Harvey, Life of Sir William Osler, Review of, 1209.
Cystica Fibrosa, Osteitis, 869.
Cysts, Entero-mesenteric, 795, 880; of the Liver, Multiple, 548.

D

Dailey, Ulysses Grant: Patent Urachus, 1047.
Dandy, Walter E.: The Diagnosis and Localization of Spinal Cord Tumors, 223.
Deaver, Harry C.: Cholecystectomy and Cholecystostomy, 879; Entero-mesenteric Cysts, 880.

DEAVER, JOHN B.: Cholecystectomy; External and Internal Cholecystostomy, 761, 878; the Surgery of Jaundice, 287.
DEBAYLE, HENRI: Gastric Tetany, 622.
Dermoids, Ovarian, 821.
Diaphragmatic Hernia, Traumatic, 1026.
DICKINSON, ARTHUR M.: Chronic Post-cæcal Suppurative Appendicitis Causing Lumbar Abscess, 1049.
Dilatation, Idiopathic (so-called) of the Œsophagus, 59, 466.
Dislocation, Complete Posterior, of Left Ankle-joint, 881; of Knee with Rupture of Anterior Crucial Ligament, 550; of Patella, Bilateral Congenital External, 876; of the Shoulder, the Treatment of Chronic Recurrent, by Crucial Capsular Plication, 143.
Dislocation—Fracture, of the Carpus, 871.
Diverticulitis of the Colon, 322.
DOUGLAS, JOHN: Carcinoma of the Face with Plastic, 714; Carcinoma of the Tongue, 717; Cirrhosis of the Liver—Omentopexy, 712; Gunshot Injury to the Brachial Plexus, 719; Gall-bladder Surgery, 1198; Gall-stones Ulcerating into Bowel, 1185; Hernia of the Triangle of Petit, 711.
DOWD, CHARLES N.: The Surgical Treatment of Cleft Palate, 573, 708.
Duodenal Ulcer, The Operative Treatment of, with Special Reference to the Horsley Operation, 631; the Rôle of the Pyloro-duodenal Nerve Supply in the Surgery of, 939.
Duodeno-jejunostomy, 514, 791.
Duodenum, Acute Perforation of the, Suture on Heineke-Mikulicz Principle, 872; and Stomach, Hour-glass, 313.

E

Early Days of the ANNALS OF SURGERY, 1.
Editorial Work, Fellow Workers' Appreciation of Two Scores of Years of, 410.
EGGERS, CARL: Carcinoma of Upper Œsophagus and Pharynx, 695; Removal of Carcinoma of Œsophagus with Recovery, 693.
EISBERG, HARRY BELLEVILLE: On the Viability of the Intestine in Intestinal Obstruction, 926; Electric Burn Complicated by Tetanus, 542.
ELIASON, ELDRIDGE LYON: Surgical Emergencies of the Abdomen, 917.
ELSBERG, CHARLES A.: Craniotomy under Local Anæsthesia, 213; Diagnosis and Treatment of Tumors of the Spinal Cord, 1057.
Endothelioma, Cranial, 1036.
Entero-mesenteric Cysts, 795, 880.
ERDMANN, JOHN F.: Gall-bladder Surgery, 1196; the Operative Treatment of Duodenal Ulcer with Special Reference to the Horsley Operation, 631.
ESTES, WILLIAM LAWRENCE: Amputations in Industrial Surgery, 164.
EVANS, WILLMOTT H.: Diseases of the Breast, Review of, 891.
Exophthalmic Goitre with Large Thymus, 727; the Effect of Administration of Iodine upon, 739.
Extroverted Bladder, Transplantation of into Rectum, 1212.

F

Face, Carcinoma of the, with Plastic, 714.
Fascial Strip Repair of Femoral Hernia, 1009.
FAURE, JEAN LOUIS: Treatise on Cancer of the Uterus, Review of, 1209.
Fellow Workers' Appreciation of Two Scores of Years of Editorial Work, 410.
Femoral Arteriovenous Aneurism, 551.
Femoral and Inguinal Canals, Some Unusual New Growths in the Region of the, 335.
Femoral Hernia, Fascial Strip Repair of, 1009.
Femur, The Abduction Treatment of Fracture of Neck of the, 374; Fracture of, with Pin Traction and Tong Suspension, 1188.
FERGUSON, L. K.: The Early Treatment of Superficial Burns, 439.
Fibroma, Ovarian, Sarcoma Associated with, 674.
FINNEY, JOHN M. T.: Spasmodic Torticollis, 255.
Fistula, Arteriovenous, Congenital, of Left Brachial Artery and Vein with Secondary Arterial Blood Supply to the Arm, 461; Internal Biliary, 305; Thoracic Duct, Post-operative, 701; Urinary, Perineal, Urethral, 1182.
Fitzwilliams' Treatise on the Breast, Review of, 1208.
FOWLER, FRANK E.: Hernia following the Use of the McBurney Incision in Operations for Appendicitis, 525.

Fracture at Ankle, Rare Form of, 1199; of a Bone-graft, 1199; Calamities and Their Management, 111; Compound Depressed, of Cranial Vault, 1025; of Femur, with Pin Traction and Tong Suspension, 1188; of the Neck of the Femur, The Abduction Treatment of, 374; Unrecognized, of the Cervical Spine with Late Cord Symptoms, 870; Compound, of the Olecranon Associated with Fracture at Wrist, 540.

Fractures, Frontal, of the Patella, 536; Spiral, Theory and Treatment of, 368.

Fracture-dislocation of the Carpus, 871.

Fresh Tissue, Microscopic Examination of, and Necropsy, Service in Relation to Surgery, 863.

Frontal Lobes of the Brain, Method of Exposing Anterior Portions of the, 1053.

G

Gall-bladder, Gall-stones and Diseases of the, 955; Rupture of, with Gangrenous Cholecystitis, 1183; and Ducts, Surgery of the, 961, 1196.

Gall-stone Fecolith, Causing Bowel Obstruction, 1184.

Gas-bacillus Infection with Appendicitis, 1178.

Gas Gangrene, 198.

Gastric Tetany, 622.

Gastric Ulcer, Final Results of the Operative Treatment of, 1102.

Gentian Violet in Cases of Extreme Septicæmia, Results of the Intravenous Use of, 687.

GERMAN, WILLIAM McK.: Mucous Membrane Polyp of the Appendix, 522.

GIBSON, CHARLES L.: Acute Perforation of the Duodenum, Suture on Heineke-Mikulicz Principle, 872; the Tongue Depressor Gastro-enterostomy Clamp, 872; Valvular Cæcostomy for Colitis, 873.

Glioma, Irremovable High Cervical Cord, Radiotherapy, 1008.

Gliomas of the Brain, Some Surgical Aspects of the Pathology of, 893.

Globus Major, Descent of the, with Retention of Testis in the Abdominal Cavity, 885.

Goitre, Exophthalmic, The Effect of Administration of Iodine upon, 739; with Large Thymus, 727.

Goitre-surgery, Practical Points in Connection with, 270.

GOLDSMITH, RALPH: Kienboch's Disease of the Semilunar Bone, 857, 880.

GRACE, RODERICK V.: Rupture of the Bladder, 1007.

Graft, Bone, Fracture of, 1199; after Removal of Giant-cell Tumor, 1204.

GRAHAM, HENRY F.: Duodeno-jejunostomy, 514, 791.

GRANT, FRANCIS C.: A Suggestion for the Relief for the Pain from Carcinoma of the Mouth and Cheek, 490; Cranial Endothelioma, 1036.

GRAVES, W. N.: Final Results of Operative Treatment of Gastric Ulcer, 1102.

Gummata, Kidney, 495.

Gunshot Injury to the Brachial Plexus, 719.

HANDLEY, W. SAMPSON: Lupus in its Surgical Aspects 9; Portrait of, 457.

HANRAHAN, EDWARD M., JR.: Splenic Blood Disorders, 906.

HARTWELL, JOHN A.: Neuro-epithelioma of the Spinal Cord, 413; Syphilis of the Stomach, 767.

H

Heart, Suture of Stab Wound of the, 757.

HEPBURN, THOMAS N.: Spastic Obstruction to the Ureters, 1133.

HERMAN, LEON: Prostatic Abscess, 1115.

Hernia following Use of the McBurney Incision in Operations for Appendicitis, 525; Femoral, Fascial Strip Repair of, 1009; Inguinal, The Suture of the Aponeurosis of the Internal Oblique Muscle to the Ligament of Poupart for the Cure of, 833; Sliding, The Rational Treatment of, 330; Traumatic Diaphragmatic, 1026; of the Triangle of Petit, 711.

HERRICK, FREDERICK C.: Tuberculoma of the Cæcum, 801.

HEUER, GEORGE J.: The Experimental Transplantation of the Diaphragm as an Adjunct in the Treatment of Lesions at the Lower End of the Œsophagus, 273.

HIGGINS, CHARLES: Benign Tumors of the Stomach, 949.

HINTON, DRURY: Results of the Intravenous Use of Gentian Violet in Cases of Extreme Septicæmia, 687.

Hip-joint, Arthritis Deformans of, Operative Treatment of, 1108.
Horn, Harry W.: Polyposis of the Appendix Vermiformis with Intussusception of the Appendix, 1002.
Horsley, J. Shelton: Some Unusual New Growths in the Region of the Inguinal and the Femoral Canals, 335.
Horsley Operation, The Operative Treatment of Duodenal Ulcer with Special Reference to the, 631.
Hour-glass Stomach and Duodenum, 313.
Hughson, Walter: Spasmodic Torticollis, 255.
Hydronephrosis, Perirenal, 498.

I

Ileo-cæcal Tuberculosis Producing Acute Intestinal Obstruction, Situs Inversus Totalis Complicated by, 507.
Ileum, Adhesions of the, The Result of Appendicitis, 563.
Industrial Surgery, Amputations in, 164.
Inguinal Canal, Lipoma of the, 884.
Inguinal and Femoral Canals, Some Unusual New Growths in the Region of the, 335.
Inguinal Hernia, The Suture of the Aponeurosis of the Internal Oblique Muscle to the Ligament of Poupart for the Cure of, 833.
Injuries about the Wrist-joint, Statistical Results of the Radiographic Study of, 532.
Intestinal Anastomosis, Aseptic End-to-End, 646.
Intestinal Obstruction, Situs Inversus Abdominalis, Complicated by Ileo-cæcal Tuberculosis Producing, 507.
Intestine, On the Viability of the, in Intestinal Obstruction, 926.
Intracranial Injuries, Management of, with or without Fracture, 901.
Intravenous Use of Gentian Violet, Results of the, in Cases of Extreme Septicæmia, 687.
Intussusception, Acute, in Children, 637; of the Appendix, Polyposis of the Appendix Vermiformis with, 1002.
Inversus Abdominalis, Situs, Complicated by Ileo-cæcal Tuberculosis Producing Acute Intestinal Obstruction, 507.
Iodine upon Exophthalmic Goitre, The Effect of Administration of, 739.
Italian Method, Repair of Nasal Defect of, 1044.
Ivy, Robert H.: Swellings of the Submaxillary Region, 605.

J

Jackson, Arnold S.: The Effect of Administration of Iodine upon Exophthalmic Goitre, 739.
Jacobson, W. H. A.: Portrait of, 401.
Jaundice, Its Pathological Physiology, 299; Latent, as a Symptom of Biliary Colic, 108; the Surgery of, 287.
Jejunostomy, Duodeno, 514, 791.
Jejunum, Rupture of (Due to Direct Blow to Anterior Abdominal Wall), 722.
Jones, Sir Robert: Orthopædic Surgery of Injuries, Treatise on, Edited by, Review of, 1052.
Jopson, John H.: Cholecystectomy and Cholecystostomy, 878.
Judd, Edward Starr: Internal Biliary Fistula, 305.
Juxta-pyloric Ulcer, Surgery of, 149.

K

Keen, William Williams: The Early Days of the Annals of Surgery, 1.
Keetley, C. B.: Portrait of, 395.
Keller, William L.: The Treatment of Chronic Recurrent Dislocation of the Shoulder by Crucial Capsular Plication, 143.
Kidney Abscesses, Multiple, 1183.
Kidney Gummata, 495.
Kidney, Right, and Ureter, The Relation of the Appendix to the, 518; Tuberculosis of the, Clinical Notes on, 94.
Kienboch's Disease of the Semilunar Bone, 857.
Kleinberg, Samuel: Primary Sarcoma of the Spine, 433.
Klopp, Edward J.: Exophthalmic Goitre with Large Thymus, 727.
Kocher's Method, Resection of the Stomach by, 125.
Koucky, John D.: Ovarian Dermoids, 821.
Knee-joint, Dislocation of, with Rupture of Anterior Crucial Ligament, 550; Disturbance, Medio-lateral Arthrotomy for, 1017.

KREUTZMANN, HENRY A. R.: The Relation of the Appendix to the Right Kidney and Ureter, 518.

L

LAROQUE, G. PAUL: Lipoma of the Inguinal Canal, 884.
LEE, BURTON J.: Late Recurrence of Carcinoma of Breast after Extirpation, 551.
LE RICHE, RENÉ: Spinal Anæsthesia, 38.
LILIENTHAL, HOWARD: Thoracic Surgery as a Specialty, 191.
Lipoma of the Inguinal Canal, 884.
LIPSHUTZ, BENJAMIN: Perirenal Hydronephrosis, 498.
Liver, Acute Yellow Atrophy of, 1018; Amœbic Abscess of, 1023; Cirrhosis of the—Omentopexy, 712; Cirrhosis of, with Omentopexy and Splenectomy, 1024; Metastatic Abscess of, 1030; Multiple Cysts of the, 548.
Local Anæsthesia, Craniotomy under, 213; the Elimination of Morphin and Other Accessory Drugs in Operations under, 994.
LOVELAND, JOHN E.: Ovarian Cyst of Great Size—Removal with Recovery, 564.
Ludwig's Angina, 704.
Lumbar Abscess, Chronic Post-cæcal Suppurative Appendicitis Causing, 1049.
Lupus in its Surgical Aspects, 9.
Lymphosarcoma, Intestinal, Toxin Cure of, 1192; of Stomach, 1186.

M

MACGUIRE, CONSTANTINE J.: Dislocation of Knee with Rupture of Anterior Crucial Ligament, 550; Femoral Arteriovenous Aneurism, 551; Multiple Cysts of the Liver, 548.
Malignant Neoplasms, Some Unusual Cases of, 679.
MACEWEN, WILLIAM: Portrait of, 404.
MARTIN, FRANKLIN H.: Fellow Workers' Appreciation of Two Scores of Years of Editorial Work, 410.
MARTIN, WALTER: Gall-bladder Surgery, 1198.
Masters of Surgery in the Early Years of the ANNALS OF SURGERY, 3.
MATAS, RUDOLPH: Ligation of the Abdominal Aorta, 453.
MATHEWS, FRANK S.: Surgery of the Gall-bladder and Ducts, 961.
MAYO, CHARLES HORACE: Gall-stones and Diseases of the Gall-bladder, 955; Hourglass Stomach and Duodenum, 313.
MAYO, WILLIAM JAMES: Masters of Surgery in the Early Years of the ANNALS OF SURGERY, 3.
McBurney Incision in Operations for Appendicitis, Hernia following the Use of the, 525.
MCCREERY, JOHN A.: Gangrene of Common Bile Duct, 548.
MCFARLAND, JOSEPH: Surgical Pathology, Review of, 833.
MELENEY, FRANK L.: A Contribution to the Study of Thrombo-angiitis Obliterans, 976.
MENCKE, J. BERNHARD: Post-operative Complications, 1160.
Mesenteric Entero Cysts, 795, 880.
MEYER, KARL A.: Final Results of Operative Treatment of Gastric Ulcer, 1102.
MILLER, G. GAVIN: A Contribution to the Study of Thrombo-angiitis Obliterans, 976.
MOORE, GEORGE ALBERT: Situs Inversus Abdominalis Complicated by Ileo-cæcal Tuberculosis Producing Acute Intestinal Obstruction, 507.
MOORHEAD, JOHN J.: Medio-lateral Arthrotomy for Knee-joint Disturbance, 1017.
Morphin and Other Accessory Drugs, The Elimination of, in Operations under Local Anæsthesia, 994.
MOSCHCOWITZ, ALEXIS V.: The Rational Treatment of Sliding Hernia, 330.
MOYNIHAN, SIR BERKELEY: Acute Pancreatitis, 132; Transplantation of Extroverted Bladder into Rectum, 1212.
MULLEN, THOMAS F.: Plexiform Neuroma, 1093.
MULLER, GEORGE P.: Fracture of a Bone-graft, 1199; Diagnosis and Treatment of Giant-cell Tumor of Bone, 1205.

N

NARAT, JOSEPH K.: Some Unusual Cases of Malignant Neoplasms, 679.
Nasal Defect, Repair of, by Italian Method, 1044.
Nasal Passages, Adenocarcinoma of the, 1040.

NASSAU, CHARLES: Cholecystectomy and Cholecystostomy, 879.
Neck, Infections of the Submaxillary Triangle of the, The Relation of the Submaxillary Salivary Gland to, 611.
Necropsy Service in Relation to Surgery, Microscopic Examination of Fresh Tissue, 863.
Neoplasms, Malignant, Some Unusual Cases of, 679.
NEUHOF, HAROLD: Irremovable High Cervical Cord Glioma; Radio-therapy, 1008.
Neuro-epithelioma of the Spinal Cord, 413.
Neuroma, Plexiform, 1093.
New York Surgical Society, Transactions of the, 548, 693, 711, 869, 1007, 1178.

O

Obstruction, Intestinal. On the Viability of the Intestine in, 926.
Ochronosis, 1189.
OCHSNER, ALBERT J.: Practical Points in Connection with Goitre Surgery, 270.
O'CONOR, JOHN: Adhesions of the Ileum, The Result of Appendicitis, 563; Some Fracture Calamities and Their Management, 111.
Œsophagoplasty, Antethoracic, 52.
Œsophagus, Carcinoma of, Removal of, with Recovery, 693.
Œsophagus, Experimental Transplantation of the Diaphragm as an Adjunct in the Treatment of Lesions at the Lower End of the, 273.
Œsophagus, So-called Idiopathic Dilatation of the, 59, 466.
Olecranon Associated with Fracture at Wrist, Compound Fracture of the, 540.
Omentopexy or Cirrhosis of the Liver, 712; and Splenectomy or Cirrhosis of Liver, 1024; and Splenectomy, Extreme Ascites from Portal Cirrhosis Cured by Combined, 706.
Operations, Abdominal, Post-operative Complications of, 326.
Operating Table, An Improved, for General Surgery, 566.
Orthopédie, Traite Pratique d', Edited by D. G. Potel, Review of, 888.
Orthopædic Surgery of Injuries, Edited by Sir Robert Jones, Review of, 1052.
OSLER, SIR WILLIAM: Life of, by Harvey Cushing, Review of, 1209.
Osteo-chondromata, Multiple, 721.
Osteitis Cystica Fibrosa, 869.
Ovarian Cyst of Great Size, Removal with Recovery, 564.
Ovarian Dermoids, 821.
Ovarian Fibroma, Sarcoma Associated with, 674.
OWEN, HUBLEY R.: Compound Fracture of the Olecranon Associated with Fracture at Wrist, 540; Rare Form of Ankle Fracture, 1199; Severe Electric Burn Complicated by Tetanus, 542.

P

Palate, Cleft, 708; The Surgical Treatment of, 573.
Pancreatitis, Acute, 132.
Patella, Bilateral, Congenital, External Dislocation of, 876; Frontal Fractures of the, 536.
PAUCHET, VICTOR: Practical Surgery, Review of, 889.
PECK, CHARLES H.: Diverticulitis of the Colon, 322.
PENHALLOW, DUNLAP P.: Descent of the Globus Major with Retention of Testis in the Abdominal Cavity, 885.
Pennsylvania University Hospital, The Surgical Service at the, 1164.
Perirenal Hydronephrosis, 498.
Peritonitis, Drainage of the Thoracic Duct in Experimental, 911.
PERSSON, MAURITZ: Clinical Notes on Tuberculosis of the Kidney, 94.
Petit, The Triangle of Hernia of, 711.
PFEIFFER, DAMON: Prostatic Abscess, 1207.
Pharynx, and Upper Œsophagus, Carcinoma of, 695.
Philadelphia Academy of Surgery, Transactions of the, 540, 544, 727, 876, 1036, 1199.
PILCHER, JAMES TAFT: Gas Gangrene, 198.
PILCHER, LEWIS STEPHEN: Portrait of, 393.
PILCHER, LEWIS STEPHEN: Review of the Life of Sir William Osler, 1209; Story of the ANNALS, 392.
Plates and Screws after Insertion in Bone, Removal of, 528.
PLATOU, PEDRO: Duodeno-jejunostomy, 514, 791.
Plexiform Neuroma, 1093.
Polyp of the Appendix, 522.

Polyposis of the Appendix Vermiformis, with Intussusception of the Appendix, 1002.
Post-operative Complications, 1160.
Potel, D. G.: Traité Pratique d'Orthopédie, Review of, 888.
Prostatic Abscess, 1115, 1206.
Pugh, Winfield Scott: Stricture of the Ureter, 839.
Pulmonary Tuberculosis, New Thoracoplastic Procedure for, to Lessén Incidence of Post-operative Pneumonia, 748.
Purpura Hemorrhagica, Splenectomy for, 1178.
Pyloro-duodenal Nerve Supply, The Rôle of the, in the Surgery of Duodenal Ulcer, 939.
Pylorus Spasm and its Surgical Treatment, 45.

R

Radiographic Study of Injuries about the Wrist-joint, Statistical Results of the, 532.
Randall, Alexander: Unusual Urinary Calculi, 540; Prostatic Abscess, 1206.
Ransohoff, J. Louis: Cervical Sympathectomy for Angina Pectoris, 585.
Ravdin, I. S.: The Early Treatment of Superficial Burns, 439; the Surgical Service at the Hospital of the University of Pennsylvania, 1164.
Rectum, Carcinoma of the, 1030; Extraperitoneal Resection of Carcinomatous Prolapsed; no Recurrence in Six Years, 703.
Rectum and Recto-sigmoid, Cancer of, 972.
Reid, Mont R.: The Surgical Treatment of Angina Pectoris, 591.
Reimann, Stanley P.: Jaundice—its Pathological Physiology, 299.
Renal Artery, Aneurism of the, 105.
Rhodes, Robert L.: Suture of Stab Wound of the Heart, 757.
Rixford, Emmet: Theory and Treatment of Spiral Fractures, 368.
Roberts, George W.: The Suture of the Aponeurosis of the Internal Oblique Muscle to the Ligament of Poupart for the Cure of Inguinal Hernia, 833.
Roberts, Kingsley: The Suture of the Aponeurosis of the Internal Oblique Muscle to the Ligament of Poupart for the Cure of Inguinal Hernia, 833.
Rovsing, Thorkild: Antethoracic Œsophagoplasty, 52.
Russell, James I.: Cancer of Rectum and Recto-sigmoid, 972.

S

Sachs, Ernest: Method for Exposing the Anterior Portion of the Frontal Lobes of the Brain, 1053; Some Surgical Aspects of the Pathology of Gliomas of the Brain, 893.
Santee, Harold E.: Lymphosarcoma of the Stomach, 1186; Tong Suspension and Traction for Fracture of Femur, 1188; Ochronosis, 1189.
Sarcoma Associated with Ovarian Fibroma, 674; Lympho, Intestinal, Toxin Cure of, 1192; Lympho, of Stomach, 1186; Primary, of the Spine, 433.
Schley, Winfield Scott: Gall-stone, Fecolith, Causing Bowel Obstruction, 1184.
Sellenings, Albert E.: Plastic for Hypertrophy of the Breast, 874.
Semilunar Bone, Kienboch's Disease of the, 857.
Septicæmia, Results of the Intravenous Use of Gentian Violet in Cases of Extreme, 687.
Schiassi, Benedetto: The Rôle of the Pyloro-duodenal Nerve Supply in the Surgery of Duodenal Ulcer, 939.
Schramm, Hilaire: Aneurism of the Renal Artery, 105.
Shallow, Thomas A.: Entero-mesenteric Cysts, 795, 880.
Sherwood, Walter A.: Carcinoma of the Cæcum with Intussusception of the Involved Bowel, 1028; Carcinoma of the Rectum, 1030; Compound Depressed Fracture of Cranial Vault, 1025; Traumatic Diaphragmatic Hernia, 1026.
Shoulder, The Treatment of Chronic Recurrent Dislocation of the, by Crucial Capsular Plication, 143.
Silvestrini, Luigi: Pathology and Surgery of the Spleen, Review of, 887.
Sliding Hernia, The Rational Treatment of, 330.
Smith, Morris K.: Fracture-dislocation of the Carpus, 871; Osteitis Cystica Fibrosa, 869; Ulnar Nerve Injury Attending Injury of Wrist, 870; Unrecognized Fracture of the Cervical Spine with Late Cord Symptoms, 870.

Spasm of Pylorus, and its Surgical Treatment, 45.
Spasmodic Torticollis, 255.
Spermatic Cord, Torsion of the, 1142.
Spinal Anæsthesia, 38.
Spinal Cord, Neuro-epithelioma of the, 413.
Spinal Cord Tumors, The Diagnosis and Localization of, 223, 1057.
Spine, Primary Sarcoma of the, 433.
Spiral Fractures, Theory and Treatment of, 368.
Spleen, Pathology and Surgery of the, Edited by Luigi Silvestrini, Review of, 887.
Spleen, Rupture of the, following Slight Trauma or Exertion, 729.
Splenectomy and Omentopexy, Cirrhosis of Liver with, 1024; Extreme Ascites from Portal Cirrhosis Cured by Combined, 706; for Purpura Hemorrhagica, 1178.
Splenic Blood Disorders, 906.
Stab Wound of the Heart, Suture of, 757.
STETTEN, DEWITT: Extraperitoneal Resection of Carcinomatous Prolapsed Rectum; no Recurrence in Six Years, 703; Extreme Ascites from Portal Cirrhosis Cured by Combined Splenectomy and Omentopexy, 706; Ludwig's Angina, 704; Post-operative Breast Carcinoma; Lymph-node Stationary for Many Years, 700; Post-operative Thoracic Duct Fistula, 701.
STEVENSON, LEWIS D.: Neuro-epithelioma of the Spinal Cord, 413.
STEWART, STEELE F.: Frontal Fractures of the Patella, 536.
Stomach, Benign Tumors of the, 949; Lymphosarcoma of the, 1180; Resection of the, by Kocher's Method, 125; Syphilis of the, 767.
Stomach and Duodenum, Hour-glass, 313.
Story of the ANNALS, The, 392.
Stricture of the Ureter, 839.
Submaxillary Region, Swellings of the, 605.
Submaxillary Salivary Gland, The Relation of the, to Infections of the Submaxillary Triangle of the Neck, 611.
Surgery of the Gall-bladder and Ducts, 961; Goitre, Practical Points in Connection with, 270; Industrial, Amputations in, 164; of Jaundice, 287; of Juxtapyloric Ulcer, 149; Masters of, in the Early Years of the ANNALS OF SURGERY, 3.
Surgery, Orthopædic, of Injuries, Edited by Sir Robert Jones, Review of, 1052.
Surgery, Practical, Victor Pauchet, Review of, 889.
Surgery, Thoracic, as a Specialty, 191.
Surgery, Wheeler's Handbook of, Review of, 1209.
Surgical Aspects, Lupus in its, 9.
Surgical Emergencies of the Abdomen, 917.
Surgical Pathology, Edited by Joseph McFarland, Review of, 890.
SWEET, JOSHUA E.: Cholecystectomy and Cholecystostomy, 878.
Swellings of the Submaxillary Region, 605.
Syphilis of the Stomach, 767.

T

Table, An Improved Operating, for General Surgery, Providing New Features for Urologic and Gynæcologic Work, 566.
TAKATS, G. DE: Latent Jaundice as a Symptom of Biliary Colic, 108.
Testis, Retention of, in the Abdominal Cavity, Descent of the Globus Major with, 885.
Tetanus, Severe Electric Burn Complicated by, 542.
Tetany, Gastric, 622.
Thoracic Duct, Drainage of, in Experimental Peritonitis, 911.
Thoracic Duct Fistula, Post-operative, 701.
Thoracic Surgery as a Specialty, 191.
Thoracoplastic, New Procedure for Pulmonary Tuberculosis to Lessen Incidence of Post-operative Pneumonia, 748.
THOREK, MAX: Torsion of the Spermatic Cord, 1142.
Thrombo-angiitis Obliterans, A Contribution to the Study of, 976.
Thumb, Xanthosarcoma of, 851.
Thymus, Large, Exophthalmic Goitre with, 727.
Thyroid Tumor, Carcinoma of Lateral Aberrant, 1039.
Tongue, Actinomycosis of the, 881; Carcinoma of the, 717.
Tongue Depressor, The, Gastro-enterostomy Clamp, 872.

TOREK, FRANZ: Carcinoma of Buccal Cavity, 698.
Torsion of the Spermatic Cord, 1142.
Torticollis, Spasmodic, 255.
Transfusion, Anuria Following, 733.
Transplantation of the Diaphragm, The Experimental, as an Adjunct in the Treatment of Lesions at the Lower End of the Œsophagus, 273.
TREVES, FREDERICK: Portrait of, 399.
Triangle of Petit, Hernia of the, 711.
TRUESDALE, EDWARD D.: Gall-stone Fecolith Causing Obstruction of the Bowels, 1184.
Tuberculoma of the Cæcum, 801.
Tuberculosis of the Kidney, Clinical Notes on, 94.
Tuberculosis, Pulmonary, New Thoracoplastic Procedure for, to Lessen Incidence of Post-operative Pneumonia, 748.
Tumors, Benign, of the Stomach, 949; of Bone, 1074; Spinal Cord, The Diagnosis and Localization of, 223; Spinal Cord, Diagnosis and Surgical Treatment of the, 1057.
Ulcer, Duodenal, The Operative Treatment of, with Special Reference to the Horsley Operation, 631; The Rôle of the Pyloro-duodenal Nerve Supply in the Surgery of, 939.

U

Ulcer, Juxta-pyloric, Surgery of, 149.
Ulnar Nerve Injury from Injury of Wrist, 870.
University of Pennsylvania Hospital, Surgical Service, 1164.
Urachus, Patent, 1047.
Ureter, Stricture of the, 839; The Relation of the Appendix to the Right Kidney, 518.
Ureters, Spastic Obstruction of the, 1133.
Urinary Calculi, Unusual, 540.
Urinary, Perineal Fistula, 1182.

V

Vaginal Anus, 723.
Valvular Cæcostomy for Colitis, 873.
VANDEN BERG, HENRY J.: Mucous Membrane Polyp of the Appendix, 522.
VANDER VEER, EDGAR A.: Chronic Post-cæcal Suppurative Appendicitis Causing Lumbar Abscess, 1049.
VERMOOTEN, VINCENT: Xanthosarcoma of Thumb, 851.
Viability of the Intestine in Intestinal Obstruction, 926.

W

WEBSTER, JEROME P.: Aseptic End-to-End Intestinal Anastomosis, 646.
Wheeler's Handbook of Surgery, Review of, 1209.
WHIPPLE, ALLEN O.: Acute Yellow Atrophy of Liver, 1018; Amœbic Abscess of Liver, 1023; Cirrhosis of Liver with Omentopexy and Splenectomy, 1024.
WHITE, J. WILLIAM: Portrait of, 397.
WHITMAN, ROYAL: The Abduction Treatment of Fracture of the Neck of the Femur, 374; Operative Treatment of Arthritis Deformans of the Hip-joint, 1108.
WILLARD, DEFOREST P.: Bone Graft Fracture, 1203.
WILSON, LOUIS B.: Microscopic Examination of Fresh Tissue and Necropsy Service in Relation to Surgery, 863.
WORCESTER, JAMES N.: Multiple Osteochondromata, 721; Traumatic Rupture of Common Bile Duct, 720.
Wrist, Injury of, Ulnar Nerve Injury from, 870.
Wrist-joint Injuries, Statistical Results of the Radiographic Study of, 532.

X

Xanthosarcoma of Thumb, 851.

Y

YOUNG, HUGH H.: An Improved Operating Table, for General Surgery, Providing New Features for Urologic and Gynæcologic Work, 566.

Accurate Chlorine Concentration

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